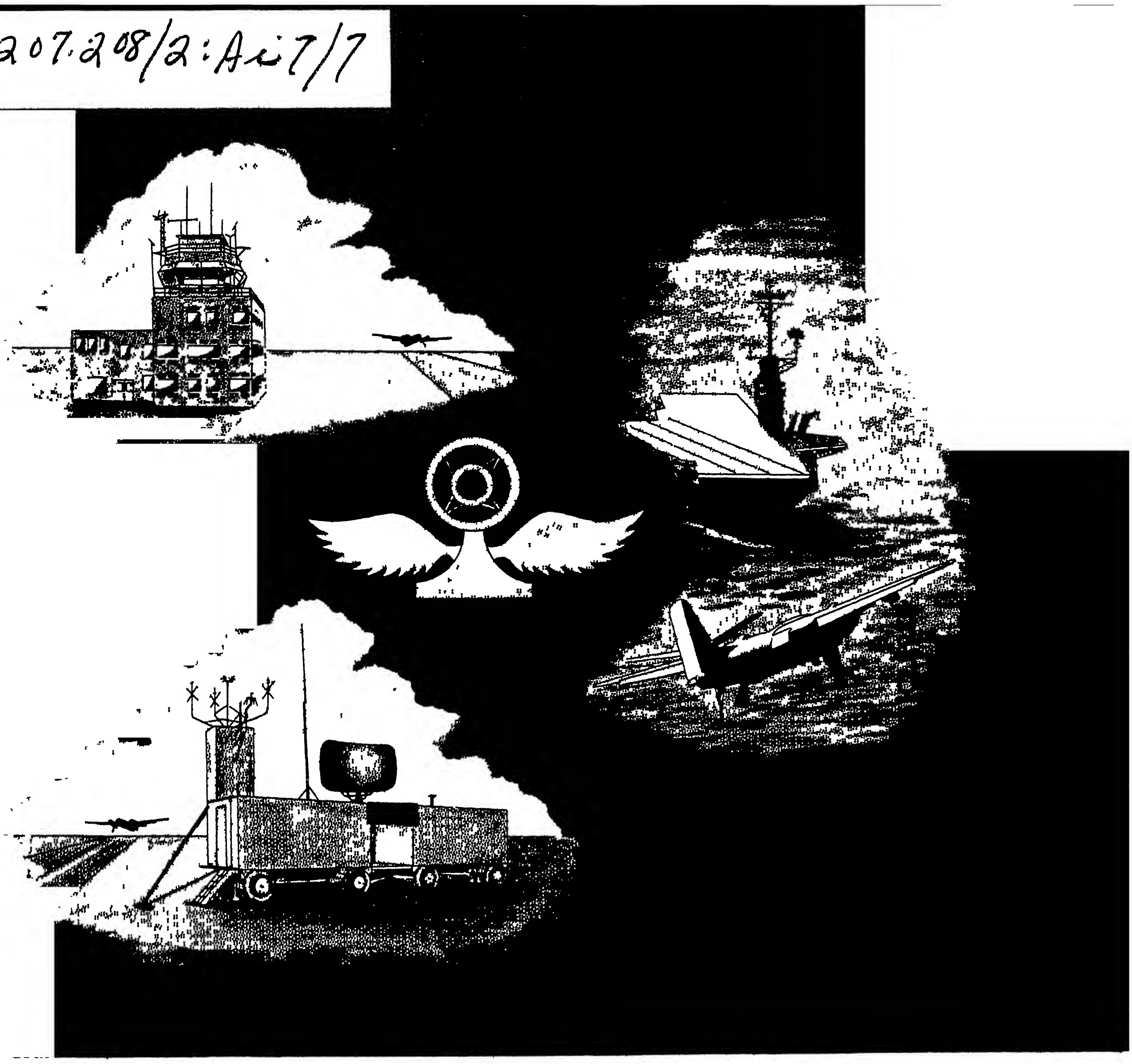

AIR TRAFFIC CONTROLLER 3 & 2

NAVAL EDUCATION AND TRAINING COMMAND

RATE TRAINING MANUAL AND NONRESIDENT CAREER COURSE

NAVEDTRA 10367-G

Although the words "he," "him," and "his" are used sparingly in this manual to enhance communication, they are not intended to be gender driven nor to affront or discriminate against anyone reading *Air Traffic Controller 3 & 2*, NAVEDTRA 10367-G.

Naval Education And Training Program Development Center

AIR TRAFFIC CONTROLLER
3 & 2

NAVEDTRA 10367-G

1983 Edition Prepared by
ACCM James T. Pruett

PREFACE

This Rate Training Manual is one of a series of training manuals prepared for enlisted personnel of the Navy and Naval Reserve who are studying for advancement in the Air Traffic Controller (AC) rating. As indicated by the title, this manual is based upon the professional qualifications for the rates of AC3 and AC2, as set forth in the *Manual of Qualifications for Advancement*, NAVPERS 18068 (Series).

The associated Nonresident Career Course for *AC 3 & 2* is included as the last section of this manual. The AC 3 or AC2 will be greatly assisted in preparing for the advancement examination by making full use of these study aids. This manual and the attendant Nonresident Career Course are valuable aids as review sources for those ACs preparing for advancement. Their use for everyday on-the-job training is highly recommended.

This training manual was prepared by the Naval Education and Training Program Development Center, Pensacola, Florida, for the Chief of Naval Education and Training. Technical review of the manuscript was provided by personnel of the AC Schools, NATTC Memphis, Millington, Tennessee.

1983 Edition

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THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

CONTENTS

CHAPTER 1

AIR TRAFFIC CONTROLLER RATING

This Rate Training Manual is designed as a self-study text to prepare you to meet the professional requirements for advancement to Third and Second Class Air Traffic Controller (AC).

Minimum professional requirements for advancement in all ratings are listed in the *Manual of Navy Enlisted Manpower and Personnel Classification and Occupational Standards*, NAVPERS 18068 (Series). The occupational standards upon which this manual is based are those appearing in Series E of NAVPERS 18068. You must keep in mind that any subsequent changes to the Occupational Standards Manual may not be reflected in the information in this training manual.

Governing directives for the control of aircraft are constantly changing in order to ensure a program of safety based on updated procedures. While the material used in this training manual reflects the policies that were current at the time that this manual was prepared, some changes which are bound to occur from time to time may outdate certain material. You must remember that this manual contains training information only and SHALL NOT be interpreted as a directive or instruction. It is not intended that any portion of this text supersede current instructions, manuals, or other technical publications in the performance of your daily duties as an Air Traffic Controller.

In this training manual, the subject matter is developed by a series of Learning Objectives which support one or more occupational standards. Each sets a learning goal for you. The text that follows the objective gives you the information you need to reach that goal. The exercises which follow the information provide you with a means of checking on how well you are doing. When you complete them, see if your answers match those in appendix A. If your response to an exercise is incorrect, review the objective and its text and try to find out how you were wrong.

The Nonresident Career Course (NRCC) for this Rate Training Manual (RTM) has been included at the end of the text material. The NRCC is a series of open-book assignments which consist of multiple choice, true-false, and matching items. It is designed to assist you in the training you need to fulfill your job requirements, and it will be of benefit to you when you are preparing for the Navy-wide advancement examination. A separate errata sheet or supplement may be included with this training package if there are changes to the text material of the RTM or NRCC. Correct your copy using the information in the errata before you start to study. Also read the preliminary pages of the NRCC thoroughly for complete information before you proceed with the course.

AC RATING

Learning Objective: **Identify the AC field entry requirements, duties, and Navy Enlisted Classification (NEC) codes.**

The present Navy enlisted rating structure includes two types of ratings: general ratings and service ratings.

General ratings are designed to provide paths of advancement and career development. A general rating identifies a broad occupational field of related duties and functions requiring similar aptitudes and qualifications. General ratings provide the primary means used to identify billet

requirements and personnel qualifications. Both regular Navy and Naval Reserve personnel may hold general ratings.

Subdivisions of certain general ratings are identified as service ratings. These service ratings identify areas of specialization within the scope of some general ratings. Service ratings are established in those general ratings in which specialization is essential for efficient utilization of personnel. Although service ratings can exist at any petty officer level, they are most common at the PO3 and PO2 levels. Both regular Navy and Naval Reserve personnel may hold service ratings.

The Air Traffic Controller (AC) rating is a general rating and is included in Navy Occupational Field 7 (air traffic control). There are no AC service ratings.

Third and Second Class Air Traffic Controllers perform air traffic control (ATC) duties at naval Air Traffic Control Facilities (ATCFs) ashore and Carrier Air Traffic Control Centers (CATCCs) on ships.

The complex of functions that comprise an ATCF ashore includes the airport control tower, radar control facilities, and flight planning/approval branch.

ACs detailed to aircraft carriers operate Carrier Controlled Approach (CCA) equipment and provide many of the same flight planning services in the Air Operations (AirOps) branch as those offered ashore.

The primary mission of ACs is the safe, orderly, and expeditious movement of air traffic under varying weather conditions. In performing this mission, Navy ACs:

1. Control air traffic at airfields and on aircraft carriers.
2. Direct air traffic by means of radio, radar and flashing light signals.
3. Operate field lighting systems and traffic control lights.
4. Communicate with aircraft by voice radio.
5. Provide aircraft with information regarding air traffic, navigation, and weather conditions—including local ceiling, visibility, and clouds.
6. Operate and make adjustments to ground-controlled approach and carrier-controlled approach systems.
7. Assist pilots in the preparation and processing of flight plans and clearances.
8. Maintain current flight planning information publications and aeronautical charts and maps.

In performing the above tasks, Navy ACs must comply with both Federal Aviation Regulations (FARs) and Navy directives.

To aid you as an AC in the performance of your duty, you will use such devices as teletypewriters, radio-telephones, light signals, light systems, carrier and ground controller approach systems incorporating precision, surveillance, and secondary radar (IFF/SIF) systems.

There are special requirements which are necessary to become and AC. They are:

1. Meet the physical requirements contained in Article 15-69, Manual of the Medical Department, U.S. Navy; and pass the examination for a Second Class Federal Aviation Administration (FAA) Medical Certificate (Part 67, Federal Aviation Regulations).

2. Meet one or more of the following training or experience requirements:

(a) Satisfactorily complete the FAA Airman Written Test Report for Control Tower Operators (AC Form 8080-2) or other acceptable evidence of having passed the airman written test.

(b) Be a graduate of the Naval Basic ATC Controller Course (Class A1 School).

(c) Be a graduate of the formal basic Air Traffic Controller Course of another service or agency which includes precision approach radar (PAR) practical application.

3. Be eligible for access to classified information.

DUTY ASSIGNMENTS

The Navy AC is required to be a professional air traffic controller, knowledgeable in all areas of air traffic control and a professional military person who transfers from one activity to another at regular intervals. In addition to ATCFs and CATCCs previously mentioned, you can be assigned to a number of other types of duty.

In order to familiarize you so that you can have an idea of what kind of duty to expect, some examples of differing duty stations are included.

1. Navy Fleet Air Control and Surveillance Facilities (FACSFAC). Fairly new to the Navy, these facilities have the responsibility for the management of some 31 major coastal operating areas (OPAREAs). Within these areas, extensive military training missions and research, development, test, and evaluation operations are conducted involving the use of airspace, the surface, and subsurface. AC is one of many enlisted ratings assigned to FACSFACs. Your primary mission at this activity is to provide air traffic control services to aircraft going to and from or transiting to and from the OPAREAs and coordinating search and rescue operations.
2. Amphibious Assault Ship (LPH). You may be assigned duties in the Helicopter Direction Center (HDC) as an arrival or departure controller and provide radar ATC service for tactical helicopter missions in support of amphibious operations.
3. Tactical Air Control Group and Squadron (TACRON). You may be assigned duties in TACRONs as arrival, holding, and as a departure controller for aircraft conducting close air support missions within the amphibious objective area. You would operate radio-telephone equipment relaying movement, tactical, and administrative messages for coordination with other agencies.
4. Instructor billets. As a petty officer, you can also fill one of the instructor billets at Naval Air Technical Training Center (NATTC), NAS Memphis, for various courses pertinent to air traffic control and facility management. Instructor billets at the Fleet Combat Direction Systems Training Center, San Diego, California, are also authorized to which you could be assigned.
5. Miscellaneous billets.

(a) As a senior AC you could be assigned to the office of the Department of the Navy Representative (NAVREP) at the regional headquarters in the FAA eastern, southern, southwest, and western regions.

(b) As a senior AC you may also be assigned as the technical advisor/writer for the Air Traffic Controller Rate Training Manuals, and/or as the exam writer for the AC fleet-wide rating exams, which are prepared at the Naval Education and Training Program Development Center, Pensacola, Florida.

(c) You could be assigned duty as a Navy recruiter or at a recruit training center as a petty officer in charge of a company or as a counselor.

The preceding list is not a complete listing of all the duties which are available to you. Billets and assignments will vary with the needs of the Navy. In the Bureau of Naval Personnel, the technical assistant to the AC Rating Control Officer, your "detailer," is a senior AC. The function of the detailer is to provide you with more detailed information on the billets which are available to you. Your detailer can be reached by phone or written correspondence.

AIR TRAFFIC CONTROLLER NAVY ENLISTED CLASSIFICATION (NEC) CODES

Section II of NAVPERS 18068 is the official manual of NEC (Navy Enlisted Classification) code identification of enlisted personnel and requirements. The NEC structure supplements the enlisted General and Service Rating structure in identifying personnel and billets in manpower authorizations. NEC codes reflect special knowledges and skills that identify personnel and billet requirements when the rating structure is insufficient by itself for manpower management purposes. The skills represented by NECs are an important tool in assigning ACs to a new duty station.

The NEC codes for the AC rating are as follows:

1. DG-9720 (Communications and Intelligence Specialists) is an Entry/Defense Grouping (DG) Series NEC and is assigned to E-1 through E-3 personnel who are in training as ACs but not designated strikers.
2. AC-6999 (Air Traffic Controller Basic) is an Entry Series NEC for rating conversion to AC. It identifies aptitudes and qualifications of Air Traffic Controllers that are not easily identified by the individual's rate. This NEC is assigned to designated strikers (other than ACs) and petty

officers who are in training under an approved program for change to the AC rating.

3. AC-6901 (Facility Rated Approach Controller) is a Rating Series NEC. This NEC identifies a billet requirement for a controller who is capable of providing approach control service, either radar or nonradar, at a terminal air traffic control facility for arriving and departing VFR/IFR (visual flight rules and/or instrument flight rules) aircraft and, on occasion, en route aircraft. You may be assigned AC-6901 only after getting a full facility rating at an approach control facility. Facility ratings are explained later in this chapter.

4. AC-6902 (CATCC Controller) is a Rating Series NEC. You must complete AC basic school (block IV) before you can be qualified for this NEC. AC-6902 identifies you as a controller who is capable of directing pilots of carrier-based aircraft in making approaches and departures on carriers using radio communications and carrier controlled approach radar systems. In addition to completing AC basic school (block IV), you must successfully complete the CATCC Controller course and qualify on all CATCC control positions before you can be assigned this NEC.

5. OS-0317 [Naval Tactical Data Systems (NTDS) Operator] is a Rating Series NEC. It identifies a billet requirement for an NTDS Input/Utilization Display Equipment Operator. You must complete the NTDS Tracker course before you can be assigned this NEC.

There are special series NECs that can be assigned to you, which are used to identify special skills and qualifications. For example, there are special NECs for instructors, Human Resources Development Specialists, Career Counselors, etc. However, these NECs are not just for ACs only. Anyone who has these special skills can be assigned these NECs.

NECs are grouped under one of three categories:

1. Entry Series. This includes Rating Conversion NECs and Occupational Area/Defense Grouping (DG) NECs.

2. Rating Series. These NECs relate to specific ratings such as AC, AG, AB, BM, etc.

3. Special Series. These NECs are not related to any particular rating such as 9502 Naval Instructor.

Occasionally, an AC may not qualify for any of the above classification codes. Some examples are personnel classified as DG-9720 who advance to AC3, or a graduate of the AC basic school who is designated as an AC striker or petty officer. These people are identified only by the rating designation of AC. The commonly referred to AC-0000 is NOT an Enlisted Classification Code, but the quad zeros (0000) are used where no Entry, Rating, or Special NEC is assigned. A quad zero AC is someone who is a full-fledged AC, but has not received any special training which can be identified by an NEC. In addition to the two examples above, an AC who is a certified control tower or Ground Controller Approach (GCA) operator would hold the quad zero rating designation.

EXERCISE

1-1. The Air Traffic Controller (AC) rating is assigned to what Navy Occupational Field?

1-2. What three air traffic control services/functions would you find at a Navy ATCF?

1-3. On an aircraft carrier, what branch of CATCC provides flight planning services?

1-4. What are the minimum requirements for entry into the AC rating?

1-5. What rating designation or NEC would be assigned to an AC3 who is a graduate of the Naval Basic ATC Controller Course, and is a qualified control tower operator?

1-6. Prior to being assigned an AC-6902 NEC, what requirements must be met?

CERTIFICATION AND RATING PROGRAM

The AC rating has a place only for serious, capable, and mature thinking personnel on the business end of a microphone. Every time you issue a clearance, lives and property are at stake. When a pilot accepts that clearance, he or she has placed his or her trust in you. Because of this, a great deal of preparation is required of the individual who holds the title of Air Traffic Controller. Success in this field comes from experience, from planned and serious study, from close attention to detail, from careful observation, and most of all, from hard work.

An effective ATC team requires personnel with demonstrated knowledge and ability. It needs people of good judgement who are capable of smooth and effective teamwork. As though this were not enough, it also needs personnel who are capable of split-second decisions and who have a great deal of common sense. The following section discusses some training requirements unique to the air traffic controller.

Learning Objective: **Identify Navy Controller Certification Requirements and Facility Ratings.**

MEDICAL STANDARDS

To be considered for the Air Traffic Controller rating, you must pass a rigid medical examination. If you meet the medical standards of FAR, Part 67, based on a medical examination and evaluation of your history and physical and mental condition, then you are entitled to receive an appropriate medical certificate.

Medical certificates are valid for one year from the date that they are issued and are designated as First, Second, and Third Class, with established medical standards for each class.

Air Traffic Controllers, military and civilian, must possess a Second Class medical certificate, the same as is required of commercial pilots.

Medical examinations are given by medical doctors who are qualified and designated by the FAA. The FAA has designated flight surgeons of the Armed Forces to give physical examinations to military air traffic controllers on active duty and to civilian personnel under Department of Defense (DOD) who are eligible for FAA medical certification. In addition, the medical examiner (flight surgeon) may issue or deny, as appropriate, FAA medical certificates in accordance with the regulations of Part 67 and policies of the FAA.

CERTIFICATION PROGRAM

All FAA, DOD civilian and military, and nonfederal personnel engaged in air traffic control shall be certified and facility rated in accordance with FAA Handbook 7220.1 and FAR, Part 65. Part 65 is covered in Chapter 2 of this RTM.

OPNAV Instruction 3721.1, Air Traffic Control Facilities Manual, establishes the Naval Air Traffic Controller Certification Program and augments and amplifies the certification procedures prescribed in FAAH 7220.1 and FAR, Part 65. OPNAVINST 3721.1 also requires Navy air traffic controllers to have an Air Traffic Control Specialist (ATCS) Certificate, FAA Form 7220-1 in addition to an Airman Written Test Report.

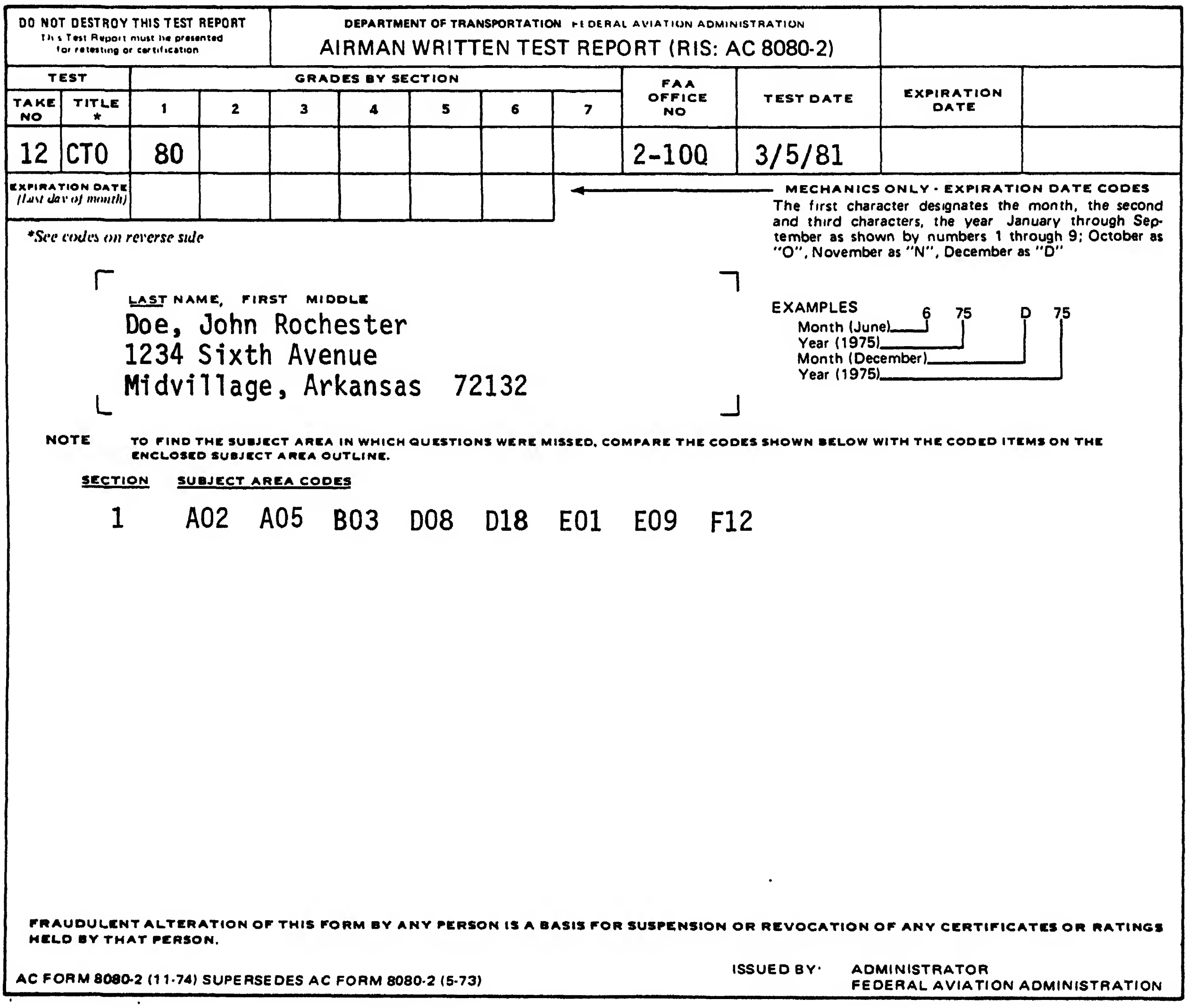
The overall certification program has three parts: (1) certification; (2) facility rating; and (3) proficiency training. In determining the job proficiency of an air traffic controller, we must consider two primary factors: (1) a written test to determine that you have a thorough knowledge of the basic rules and regulations; (2) a practical test to demonstrate your ability to apply this knowledge under actual traffic conditions.

Certification Certificates

All personnel—military officers, enlisted personnel, and civilians—performing air traffic control duties must be certified. This is done in several ways:

1. AIRMAN WRITTEN TEST REPORT (AC FORM 8080-2) FOR CONTROL TOWER OPERATOR.—This Airman Certificate signifies that the applicant has satisfactorily passed the FAA written examination for Control Tower Operator. It is the basic minimum requirement for entry into the AC field. The certificate can be obtained either through your local FAA CTO Examiner or upon successful completion of the Naval Basic ATC Controller Course. (See figure 1-1.)

2. CONTROL TOWER OPERATOR (CTO) CERTIFICATE (AC FORM 8060-1).—This Airman Certificate is also administered by the FAA. It indicates the holder is qualified to perform the duties of a control tower operator at a particular airport. This certificate is issued only after the applicant has passed a locally prepared



DO NOT DESTROY THIS TEST REPORT
This Test Report must be presented for retesting or certification

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION
AIRMAN WRITTEN TEST REPORT (RIS: AC 8080-2)

TEST TAKE NO	TEST TITLE *	GRADES BY SECTION 1	2	3	4	5	6	7	FAA OFFICE NO	TEST DATE	EXPIRATION DATE	
12	CTO	80							2-10Q	3/5/81		
EXPIRATION DATE (last day of month)												

*See codes on reverse side

MECHANICS ONLY - EXPIRATION DATE CODES
The first character designates the month, the second and third characters, the year January through September as shown by numbers 1 through 9; October as "O", November as "N", December as "D"

EXAMPLES 6 75 D 75
Month (June)
Year (1975)
Month (December)
Year (1975)

LAST NAME, FIRST MIDDLE
Doe, John Rochester
1234 Sixth Avenue
Midvillage, Arkansas 72132

NOTE TO FIND THE SUBJECT AREA IN WHICH QUESTIONS WERE MISSED, COMPARE THE CODES SHOWN BELOW WITH THE CODED ITEMS ON THE ENCLOSED SUBJECT AREA OUTLINE.

SECTION	SUBJECT AREA CODES							
1	A02	A05	B03	D08	D18	E01	E09	F12

FRAUDULENT ALTERATION OF THIS FORM BY ANY PERSON IS A BASIS FOR SUSPENSION OR REVOCATION OF ANY CERTIFICATES OR RATINGS HELD BY THAT PERSON.

AC FORM 8080-2 (11-74) SUPERSEDES AC FORM 8080-2 (5-73)

ISSUED BY: ADMINISTRATOR FEDERAL AVIATION ADMINISTRATION

Figure 1-1.—Sample AC Form 8080-2, Airman Written Test Report.

CTO facility rating examination that demonstrates he or she is qualified to operate every control tower position at that airport. (See figure 1-2.)

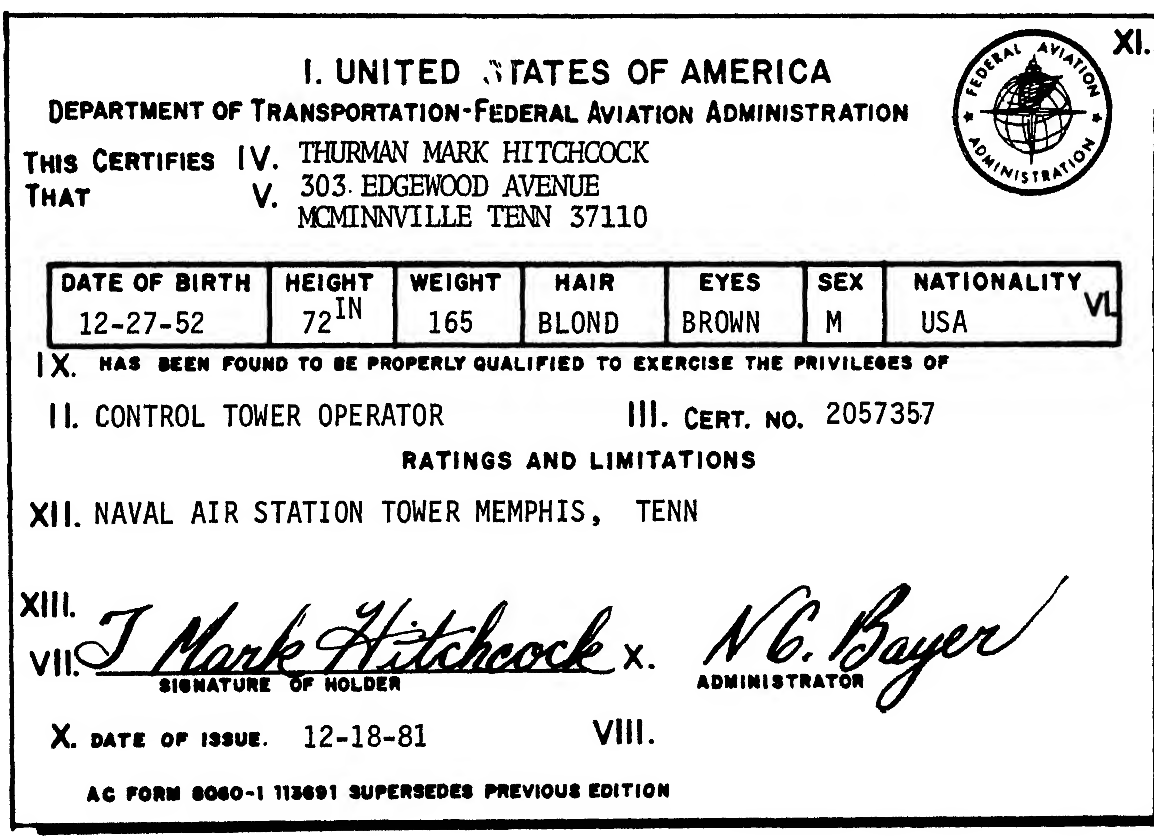
3. AIR TRAFFIC CONTROL SPECIALIST (ATCS) CERTIFICATE (FAA FORM 7220-1).—This certificate is issued to Navy personnel by authority of the Chief of Naval Operations and authorizes the holder to act as a Naval Air Traffic Controller. Each Navy AC is required to have the ATCS Certificate regardless of how he or she is employed; i.e., tower controller or radar controller. However, this certificate cannot be used by any control tower operator in lieu of the AC Form 8060-1. (See figure 1-3.)

The Naval Air Technical Training Center, Memphis, TN, documents and issues ATCS Certificates (without a facility rating) upon satisfactory completion of the Basic ATC Controllers Course.

Facility Ratings

A facility rating is an endorsement to the basic FAA certificate which certifies that the applicant has demonstrated the competence, qualifications, and skills required to control air traffic at a specific location. You have already been introduced to one type of facility rating—the CTO facility rating, which is an endorsement to the AC Form 8060-1 Certificate for Control Tower Operators. The other facility ratings that may be assigned are:

1. Approach Control (APC) Rating. A rating to the ATCS Certificate indicating the holder is qualified as an approach controller at a non-radar (manual) approach control facility.


I. UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION-FEDERAL AVIATION ADMINISTRATION
XI.
THIS CERTIFIES THAT IV. THURMAN MARK HITCHCOCK
V. 303 EDGEWOOD AVENUE
MCMINNVILLE TENN 37110

DATE OF BIRTH	HEIGHT	WEIGHT	HAIR	EYES	SEX	NATIONALITY
12-27-52	72 IN	165	BLOND	BROWN	M	USA VI.

IX. HAS BEEN FOUND TO BE PROPERLY QUALIFIED TO EXERCISE THE PRIVILEGES OF

II. CONTROL TOWER OPERATOR III. CERT. NO. 2057357

RATINGS AND LIMITATIONS

XII. NAVAL AIR STATION TOWER MEMPHIS, TENN

XIII.
VII. T Mark Hitchcock X. N. C. Bayer
SIGNATURE OF HOLDER ADMINISTRATOR

X. DATE OF ISSUE. 12-18-81 VIII.

AC FORM 8060-1 113691 SUPERSEDES PREVIOUS EDITION

201.134

Figure 1-2.—CTO and Facility Rating.

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

AIR TRAFFIC CONTROL SPECIALIST

(Signature of Holder)

This certifies that
has been found to be properly qualified to perform the duties of air traffic control specialist within areas specified in the suitably endorsed Rating Record on the reverse side hereof.

5/27/81
(Date of Issuance)

Issuing Authority

Form FAA 7220-1 (Front)

RATING RECORD

Area	Rating	Date Issued	Certifying Official
Miami	ARTCC	6/29/81	

FAA Form 7220-1 (XXXX)

Form FAA 7220-1 (Back)

Figure 1-3.—Sample FAA Form 7220-1, Air Traffic Control Specialists (ATCS) Certificate.

2. Carrier Air Traffic Control Center (CATCC) Rating. A rating to the ATCS Certificate indicating the holder has qualified for all positions of Carrier Control Approach (CCA) excluding the CCA supervisor position.

3. Flight Coordination Center (FCC) Rating. This is a rating to the ATCS Certificate, which applies to Fleet Air Control and Surveillance Facilities (FACSFAC), indicating that the holder is qualified to operate all positions of the activity, excluding the supervisory position.

4. Flight Operations Center (FOC) Rating. FOC is a rating to the ATCS Certificate, which applies to Tactical Air Control or Direction Centers and Helicopter Direction Centers, indicating that the holder has qualified for all positions specified for air traffic controllers.

5. Flight Service Station (FSS) Rating. FSS is a rating assigned to the ATCS Certificate indicating specialization in aeronautical communications services. The holder is qualified in local area knowledge, weather observations, teletypewriter, broadcast, flight data, preflight/inflight and emergency services. This rating can be issued only at facilities specifically authorized by CNO (Op-51).

6. Ground Controlled Approach (GCA) Rating. GCA is a rating given to the ATCS Certificate indicating the holder has qualified for all positions within the GCA trailer.

7. Radar Air Traffic Control Facility (RATCF) Rating. RATCF is a rating assigned to the ATCS Certificate indicating the holder is qualified to operate all positions within a radar facility other than approach control. This rating applies to those facilities providing terminal radar ATC services from a radar room type environment.

8. Radar Final Controller (RFC) Rating. RFC is a rating assigned to the ATCS Certificate indicating the holder is qualified as a Precision Approach Radar (PAR) or Airport Surveillance Radar (ASR) final controller. This rating applies primarily to joint use facilities; i.e., facilities which are used and staffed jointly by FAA and military personnel. At a joint use facility, approach control service is provided by FAA personnel, and military personnel provide radar final control. However, the Administrator and the CNO have authorized and highly recommended cross training and rating of civil and military controllers at joint use facilities.

At facilities where TRACON or RATCF ratings are applicable, "radar final controller" is normally one of the position qualifications required before you can be issued a TRACON or RATCF rating. Such facilities may, however, utilize the RFC rating when manning or experience levels prohibit continued training toward a TRACON or RATCF rating.

9. Terminal Radar Approach Control (TRACON) Rating. TRACON is a rating assigned to the ATCS Certificate indicating the holder is qualified on all control positions at a radar air traffic control facility including radar approach control.

ISSUANCE OF FACILITY RATINGS

When you report to your new command, ATCF or CATCC, you must have in your possession your AWTR AC Form 8080-2 for Control Tower Operator, ATCS (without rating), and FAA Second Class Medical Certificates. You are issued a certification/qualification record, which must be kept with you throughout your Navy career. You are now ready to enter an extensive training program for a full facility rating.

During the period prior to completing the facility rating requirements, you are under the direct and constant supervision of a qualified controller. As you progress in your training and become position qualified, that is to say qualified at individual control positions, an entry is made in your training record. You may then perform duties as a controller at those positions, provided there is another qualified and certified controller present and on duty.

When the ATCF/CATCC Officer determines that you are eligible for a CTO or ATCS facility rating, you are recommended for the appropriate examination.

An individual at your facility, either military or civilian, is designated by your commanding officer and/or the FAA Regional Air Traffic Control Examiner, as the CTO/ATCS Rating Examiner. The Rating Examiner is charged with administering the CTO performance and facility rating examinations in accordance with FAR, Part 65, FAAH 7220.1, and OPNAVINST 3721.1. In some cases the Examiner is also the Training and Standardization Supervisor (TSS), and is responsible for proficiency training.

When you have successfully completed the examination, the Examiner recommends that a rating, which specifically applies to the facility where you are stationed, be issued to you. If a CTO rating is involved, the recommendation is forwarded to the FAA so that a certificate can be issued to you. If the recommendation is for one of the other facility ratings, the back of your ATCS Certificate is endorsed with the appropriate rating(s). These certificates, with ratings, are your authorization to exercise the privileges of an air traffic controller at your assigned facility.

Your CTO and ATCS Certificates are valid indefinitely unless surrendered, suspended, or revoked. Your facility rating may also be suspended or revoked. It is valid only as long as you meet the currency requirements specified in FAR, Part 65; i.e., control traffic for at least 3 of the preceding 6 months at the facility to which your facility rating applies. When you transfer to a new duty station, your facility rating is suspended, and you must start the qualification process all over again at your new station.

SUSPENSION/REVOCATION OF CERTIFICATES AND FACILITY RATINGS

Supervisors at all levels in air traffic control are responsible for the performance of controllers under their authority. Therefore, your supervisor is continuously observing and evaluating your performance. Your supervisor, in most cases, is the first person to recommend you for position qualification, facility ratings, and additional responsibilities. There also may be times when your supervisor has to recommend your certificate and/or facility rating(s) be suspended or revoked. A brief explanation of when and how your controller privileges can be nullified is contained in the following discussion.

NOTE: Standardized procedures and action for suspension/revocation of certificates and ratings are established in FAR, Part 65, FAAH 7220.1, and OPNAVINST 3721.1. These procedures are administrative in nature and are not to be considered as disciplinary action. In every case of certificate revocation, the controller concerned shall be afforded an opportunity to submit a statement to accompany the recommendation for revocation.

Your CTO and/or ATCS certificate(s) and ratings may be suspended when your performance of ATC duties could adversely affect the facility's efficiency or the safety of aircraft and personnel. Some of the cases which could cause your certficiate to be revoked are: negligence

which has caused an accident or incident, drug or alcohol abuse, a medically diagnosed character or behavior disorder, failure to obtain appropriate facility ratings within the time frames established in OPNAVINST 3721.1, or if you profess a real and profound fear of controlling aircraft.

Additionally, if you, or other ATC personnel, are involved in or appear to have contributed to an accident or an incident, you will be temporarily relieved from operational duty and referred to a military flight surgeon for physical/psychological evaluation. You MUST NOT consider this action to be a disciplinary or punitive action, nor does this action indicate that you were in anyway responsible for the accident or incident. This action is taken to permit time to prepare the facts and supporting data for an immediate facility investigation of the accident or incident, and to protect you and the naval service if human error existed or was caused by illness or extreme pressure. If, after a preliminary investigation, you are found not responsible for or contributory to the accident/incident, you can be returned to full operational duty. On the other hand, if the later, in-depth investigation shows that you were responsible for, or contributed to, the accident/incident, your certificate is suspended and the following actions shall be taken as a minimum requirement before you can be returned to operational duty:

1. There must be a detailed and complete review of the accident/incident with you, including a discussion of the circumstances related to the accident/incident.
2. You must be reevaluated on the position(s) to determine if you need additional training.
3. If you are to be retrained, the training is conducted with particular emphasis on the weaknesses revealed during the investigation.

After it has been documented that you have satisfactorily completed the actions listed above, and have demonstrated that you have the skill to perform your duties, your certificate(s) with rating(s) can be reissued.

AUTHORITY TO SUSPEND/REVOKE CERTIFICATES/FACILITY RATINGS

Remember, the FAA issues CTO certificates and ratings under the authority of the Administrator or his appointed representative. The CTO Examiner at your facility may suspend your CTO rating. If it is recommended that your CTO certificate be revoked, however, the appropriate paper work, with justification, is submitted by the ATCF Officer via the Commanding Officer to the FAA Regional Examiner. The FAA has final revocation authority for CTO certificates.

The Commanding Officer or his designated representative may suspend or revoke your ATCS facility rating(s) based upon the results of the evaluation and/or investigation as previously mentioned. If the decision is made to recommend that your ATCS certificate be revoked, your ATCS rating(s) is/are immediately suspended. The Commanding Officer submits the recommendation, with appropriate justification, to the Chief of Naval Operations. CNO(OP-51) is the final revocation authority for ATCS certificates issued to naval air traffic controllers.

The last point to be made in this section may seem harsh to you. However, it must be made and you must keep one fact in mind. It does not necessarily mean the end of your Navy career.

If your certification; i.e., medical, CTO, and/or ATCS certificate(s) is/are revoked, your qualification to be an air traffic controller has ended. Provided no military or civil law has been broken that would require disciplinary action or confinement, you may convert laterally (pay grade for pay grade) to, and receive formal training in, another Navy rating in accordance with BUPERS Manual, Article 22308180.

EXERCISE

1-7. What Federal Aviation Regulation establishes medical standards for air traffic controllers?

1-8. For what period of time are Second Class medical certificates valid?

1-9. In addition to an ATCS, what other certificate/rating is required for qualified Navy tower controllers?

1-10. Navy air traffic controllers are certified and facility rated in accordance with which Navy and FAA publications?

1-11. Of the facility ratings applicable to naval air traffic controllers, which is the only one used as an endorsement to AC Form 8060-1?

1-12. What facility rating endorsement to the ATCS Certificate, indicates that the holder is qualified to operate all positions within a radar facility excluding approach control?

1-13. Who may suspend a/an (a) CTO rating? (b) ATCS rating?

1-14. Which agency/office has the authority to revoke a/an (a) CTO certificate? (b) ATCS certificate?

ADVANCEMENT

Some of the rewards of advancement are easy to see. You get more pay. You job assignments become more interesting and more challenging. You are regarded with greater respect by officers and enlisted personnel. You enjoy the satisfaction of getting ahead in your chosen Navy career.

The advantages of advancement are not yours alone. The Navy also profits. Highly trained personnel are essential to the functioning of the Navy. By advancement, you increase your value to the Navy in two ways: First, you become more valuable as a technical specialist in your own rating; and second, you become more valuable as a person who can train others and thus make far-reaching contributions to the entire Navy.

Since you are studying for advancement to AC3 or AC2, you are probably already familiar with the requirements and procedures for advancement. However, you will find Chapter 1 of *Military Requirements for Petty Officer 3 & 2*, NAVEDTRA 10056-E, very helpful.

Remember that the requirements for advancement can change. Check with your educational services office to be sure that you know the most recent requirements.

SOURCES OF INFORMATION

As you can see, the AC rating is one of the most demanding ratings in the Navy. It would be quite impressive to claim that this RTM is the key to your success as an Air Traffic Controller, but such is not the case. No single publication can give you all the information you need to perform the duties of an AC. One of the most useful things you can learn about a subject is how to find out more about it. You should learn where to look for accurate, authoritative, up-to-date information on all subjects related to the AC rating.

Most of the publications described in this manual are subject to change or revision from time to time, some at regular intervals, others as the need arises. When using any publication that is subject to change or revision, be sure that you have the latest edition.

When using any publication that is kept current by means of changes, be sure you have a copy in which all official changes have been made. Studying cancelled or obsolete information will not help you perform efficiently or to advance; it is likely to be a waste of time and may even be seriously misleading.

In addition to the sources of information referred to throughout this RTM, there are many publications helpful to the AC which are issued by various departments of the Navy, Air Force, and the Federal Aviation Administration. Appendix C of this manual contains a listing of selected air traffic control related directives.

CHAPTER 2

FEDERAL AVIATION REGULATIONS

Navy air traffic controllers and pilots must comply with Federal Aviation Regulations (FARs) and Navy directives. Although you, as an AC, are not concerned with the physical operation of an aircraft, you must have a knowledge of the regulations which govern such operations. Based on this knowledge, you can issue instructions and information which allow pilots to operate aircraft to conform with both your Air Traffic Control (ATC) instructions and FARs.

The Federal Aviation Administration (FAA) regulates all aspects of aviation through a system of FARs. You have already been introduced to two FARs—Part 65, Certification of Control Tower Operators and Other Nonflight Crewmen, and Part 67, Medical Standards for Aviation Personnel. Appendix C contains a list of FARs and other directives related to flight and air traffic control. Your facility should maintain a complete file of those FARs and directives which are applicable to its area of operations.

The intent of this chapter is to provide you with a basic knowledge of those air traffic rules and FAA regulations that govern Navy pilots and air traffic controllers. Excerpts from the FARs that you need to know in your day-to-day work are reprinted in Appendix D of this manual. Neither this chapter nor Appendix D is intended to replace, substitute for, or supersede official regulations or directives. You need to make sure you have the latest changes and final authority. Additions, deletions, and explanations to FARs within the text of this chapter and Appendix D have been made for clarification only.

Throughout your study of this chapter, you should locate the appropriate section(s) in the excerpts provided. This enables you to become familiar with FARs and provides you with experience in selecting and interpreting FARs. In some cases, your correct response to the exercises and/or attendant Nonresident Career Course (NRCC) assignment items depends on your correct interpretation of the FARs contained in Appendix D.

The following rules of construction are contained in FAR, Part 1 (Definitions and Abbreviations) and are used in the construction of this chapter and Appendix D.

1. Words importing the singular include the plural.
2. Words importing the plural include the singular.
3. Words importing the masculine gender include the feminine.
4. "Shall" is used in an imperative sense.
5. "May" is used in a permissive sense to state authority or permission to do the act prescribed, and the words "no person may. . ." or "a person may not. . ." mean that no person is required, authorized, or permitted to do the act prescribed.
6. "Includes" means "includes but is not limited to."

CONTROL TOWER OPERATOR CERTIFICATION (FAR, PART 65)

Learning Objective: **Recognize those portions of FAR, Part 65 that apply to the issuance of air traffic control tower operator certificates and ratings and the regulations governing the use of those certificates and ratings.**

The Control Tower Operator (CTO) certificate is not just a piece of paper to help fill up your

wallet. When this certificate is properly authenticated, indicating that you have successfully passed all examinations and are fully qualified for the appropriate rating(s), it is your license to control air traffic. You had to study very hard to achieve this certification and you have every right to be pleased with your accomplishment.

GENERAL ELIGIBILITY REQUIREMENTS

The duties and responsibilities of an air traffic controller are very demanding. The rules and regulations that you must comply with to be certified as an air traffic control tower operator are no less demanding.

To be eligible for an air traffic control tower operator certificate, you must first meet several FAA requirements. These requirements are:

1. Be at least 18 years of age
2. Be of good moral character
3. Be able to read, write, and understand the English language and speak it without accent or impediment of speech that would interfere with 2-way radio conversation
4. Hold at least a second class medical certificate issued under part 67 within the last 12 months
5. Pass the Airman Written Test for Control Tower Operator.

As a Navy AC, you must also be eligible for a confidential security clearance.

APPLICATION AND ISSUANCE OF CTO CERTIFICATES/RATINGS

All Control Tower Operator (CTO) certificates and ratings are issued or revoked by the authority of the Administrator. FAR, Part 1, defines the Administrator as "the Federal Aviation Administrator or any person to whom he has delegated his authority in the matter concerned".

Normally a senior qualified controller, either military or civilian, at your facility is designated as the CTO Examiner. Acting under the authority of the FAA Administrator, the CTO Examiner may administer CTO examinations and issue the appropriate certificates and ratings. The CTO Examiner may also suspend or revoke a CTO facility rating which is an endorsement on the CTO certificate. However, the FAA has final revocation authority for the revocation of a CTO certificate. This authority is normally delegated to the FAA Regional Examiner.

If you meet the requirements of Part 65, you are entitled to an appropriate certificate and rating. However, unless authorized by the Administrator, if your CTO certificate is suspended, you may not apply for any facility rating to be added to that certificate during the period of suspension. The Administrator also requires any person whose certificate is revoked for any reason to wait for one year after the date of revocation before applying for reissuance of the same kind of certificate.

Now refer to FAR, Part 65 in Appendix D. There are several reasons given which are grounds for certificate suspension or revocation. Part 65.12, for example, states, "No person who is convicted of violating any Federal or State statute relating to the growing, processing, manufacture, sale, disposition, possession, transportation, or importation of narcotic drugs, marijuana, depressant or stimulant drugs or substances, may apply for, or be issued, a CTO certificate or a rating to be added to a certificate, for one year after the date of the final conviction." It also states that "any conviction of the above statutes is grounds for suspending or revoking any certificate(s) or rating(s) issued by the FAA Administrator." If your CTO certificate is suspended or revoked, you must return it to the Administrator upon request. Notice that the "use" of the above drugs was not mentioned. FAR, Part 67. (Medical Standards and Certification) prohibits the issuance of a second class medical certificate to any person who is dependent on drugs or alcohol. FAR, Part 67 defines dependency as the "habitual use or a clear sense of need for the drug." Without a medical certificate, you cannot be an air traffic controller.

The Navy's policy in this area is just as strict as the FAA's. OPNAVINST 3721.1 states "Any air traffic controller who is charged with violating Federal, State, or local statutes, or Navy regulations relating to the growing, processing, manufacture, sale, disposition, possession, USE, transportation, or importation of narcotic drugs,

marijuana, or depressant or stimulant drugs or substances shall be immediately suspended from all controller duties in the control tower and radar branches. This suspension shall remain in effect pending disposition of the charges." It further states, "Any air traffic controller convicted or found other than not guilty of any" of the above statutes "may have their CTO/ATCS certificate(s) and ratings revoked or suspended and action initiated for a change of rating or separation from the Naval service."

DURATION OF CERTIFICATES

A temporary CTO certificate with rating, effective for a maximum period of not more than 120 days, may be issued by the CTO Examiner once you have satisfactorily met all requirements specified in FAR, Part 65. A temporary airman certificate (FAA Form 8060-4) is shown in figure 2-1. This certificate is your license to control air traffic while your application for a permanent certificate with rating is being reviewed for approval.

The permanent CTO certificate, AC Form 8060-1 discussed in Chapter 1, is effective until surrendered, suspended, or revoked. However, the facility rating endorsement on that certificate is valid only at the air traffic control facility for which it was issued. Additionally, to keep any facility rating current, you must control air traffic within the limitations of that rating for at least three of the preceding six months or show that you still meet the requirements for your certificate and rating.

CHANGE OF NAME: REPLACEMENT OF LOST OR DESTROYED CERTIFICATES

The Department of Transportation, FAA, Airman Certification and the Aeromedical

I. UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION—FEDERAL AVIATION ADMINISTRATION
II. TEMPORARY AIRMAN CERTIFICATE

III. CERTIFICATE NO
SSN

THIS CERTIFIES THAT IV. JOHN ROCHESTER DOE
V. 3421 SEVENTH STREET
OKLAHOMA CITY, OKLAHOMA 73101

DATE OF BIRTH	HEIGHT	WEIGHT	HAIR	EYES	SEX	NATIONALITY VI.
7/7/63	71 IN	180	BROWN	BLUE	M	U. S. A.

IX. has been found to be properly qualified and is hereby authorized in accordance with the conditions of issuance on the reverse of this certificate to exercise the privileges of

Control Tower Operator

RATINGS AND LIMITATIONS
XII. TINKER TOWER, MIDWEST CITY, OKLAHOMA

XIII. PAR ONLY

THIS IS ☒ AN ORIGINAL ISSUANCE ☐ A REISSUANCE OF THIS GRADE OF CERTIFICATE

DATE OF SUPERSEDED AIRMAN CERTIFICATE

BY DIRECTION OF THE ADMINISTRATOR

EXAMINER'S DESIGNATION NO. OR INSPECTOR'S REG. NO
2-100

X. DATE OF ISSUANCE
8/8/82

X. SIGNATURE OF EXAMINER OR INSPECTOR
ROGER JONES

DATE DESIGNATION EXPIRES
USAF

VII. AIRMAN'S SIGNATURE

FAA Form 8060-4 (1-67) FORMERLY FAA FORM 1710T

201.133

Figure 2-1.—Temporary air certificate.

Certification Branches maintain a complete file of all airmen, CTO, and medical certificates and associated ratings issued by the authority of the FAA Administrator. FAR, Part 65.16 contains the addresses and procedures to use if you change your name or require a replacement for a lost or destroyed certificate. Note that when you apply for a change of name on a certificate, you must submit your current certificate(s) and a marriage license, court order, or other document verifying the change. These documents are returned to you after inspection.

You may apply for a replacement of a lost or destroyed certificate by mail or telegram. You may also obtain a telegram from the FAA confirming that you were issued a certificate. The telegram may be carried as a certificate for a period not to exceed 60 days pending receiving a duplicate certificate. There is a $2.00 charge for replacement of a lost or destroyed certificate.

In order for the FAA to maintain an up-to-date file of certificated air traffic controllers, you are required to give the Airman Certification Branch a written statement of your new permanent mailing address within 30 days after any change.

TRAINING AND TESTING PROCEDURES

Learning to become an air traffic controller is like learning to drive an automobile. You cannot just read a book, take a test, and drive off. Practical experience, that is to say actually driving a car for a period of time, or as in this case controlling air traffic, is the best teacher. Similarly, you can compare the certification, or licensing, of an air traffic controller to the licensing of a driver. To obtain a driver's license, you had to demonstrate to a trooper your knowledge of the rules of the road, road signs, and speed limits, and your skill in operating an automobile using that knowledge. To obtain a CTO certificate, you must, for a period of time, control air traffic under the supervision of a certified controller. This is to allow you time to gain experience. Next, you must demonstrate to the Examiner that you possess the knowledge and skill required for the applicable certificate and/or rating.

Practical Experience Requirements

The FAA requires each applicant for an initial CTO rating to serve as a control tower operator without a rating for at least six months, or to serve as a control tower operator with a CTO rating at a different control tower for at least six months, before the date of application. As a Navy AC, you meet the FAA's requirements as long as you have satisfactorily served as an air traffic control tower operator for at least six months.

Testing—General

A combination of written, oral, and practical tests are used to evaluate your knowledge of ATC rules, and your air traffic control skill. The minimum passing grade for all tests is 70%. If you fail any test, be it written, oral, or practical, you must wait 30 days before applying for retesting. However, if you present a signed statement from a certified controller that you have received additional training in those subjects failed and the controller considers you ready for retesting, you may retake that part of the test before the 30-day period has expired.

Knowledge Requirements

In Chapter 1, we discussed the Airman Written Test for a Control Tower Operator. This test evaluated your knowledge of:

1. The flight rules in FAR, Part 91
2. Airport traffic control procedures
3. En route traffic control procedures
4. Communications operating procedures
5. Flight assistance service
6. Air navigation, and aids to air navigation
7. Aviation weather.

Skill Requirements

As you progress, through each operating position, toward a CTO facility rating, your skills are being evaluated. The final evaluation is a practical test for each operating position on:

1. Control tower equipment and its use
2. Weather reporting procedures and use of reports

3. Notices to Airmen and use of the Airman's Information Manual
4. Use of operational forms
5. Performance of noncontrol operational duties
6. Each of the following procedures that is applicable to that operating position and is required by the person examining you:

a. The airport, including rules, equipment, runways, taxiways, and obstructions

b. The control zone, including terrain features, visual checkpoints, and obstructions

c. Traffic patterns and associated procedures for use of preferential runways and noise abatement

d. Operational agreements

e. The center, alternate airports, and those airways, routes, reporting points, and air navigation aids used for terminal air traffic control

f. Search and rescue procedures

g. Terminal air traffic control procedures and phraseology

h. Holding procedures, prescribed instrument approach, and departure procedures

i. Radar alignment and technical operation

j. The application of the prescribed radar and nonradar separation standard, as appropriate.

All individuals performing air traffic control duties at operational air traffic control facilities, without direct supervision by another person responsible for that position, must be either position certified or facility rated. This is where your skill is tested. When you are considered qualified on a specific position, i.e., flight data or ground control, you may be position certified. This means that you may operate that position as long as there is a qualified and certified controller present and on duty. Once you are facility rated, you are authorized to work at, or monitor a trainee on, any control position within that facility.

Type Training

Training for a facility rating, whether it be for a CTO or ATCS certificate, consists of two phases. These phases are: (1) classroom, and (2) on-the-job training (OJT).

The classroom portion provides formal instruction and/or self-study material which covers the prerequisite knowledge necessary for you to perform the duties related to each operating position within your facility.

OJT is performance oriented skill training where you gain practical experience applying the knowledge that you have acquired.

Time Limits

Once you have become skilled as an air traffic controller and are facility rated, the time you spend in training for a facility rating should not take as long as your first rating. The Navy has established some guidelines to reflect the maximum number of productive training hours (PTH) it should take a proficient controller to obtain a new rating. A productive training hour is defined as a sixty-minute period during which meaningful OJT is accomplished at an operating position. (See Table 2-1.) The time limits are established by operating position i.e., flight data, approach control, radar final control, etc. and whether or not you have previously held a similar rating.

PERFORMANCE OF DUTIES

As we said earlier, once you have obtained a CTO facility rating, you are authorized to control traffic at any operating position at that control tower. However, you cannot issue air traffic clearances for IFR (Instrument Flight Rules) flight without authorization from the appropriate ATC facility (approach/departure control or en route Air Traffic Control Center) exercising IFR air traffic control functions for your location.

Whenever you are performing air traffic control duties, you must do so in accordance with the limitations on your certificate(s). You must use the procedures and practices prescribed in air

Table 2-1.—Maximum production training hours (PTH)

	INITIAL (Note 1)	SUBSEQUENT (Note 2)
CONTROL TOWER		
Flight Data	80	40
Ground Control	80	40
Clearance Delivery	80	30
Local Control	160	90
Approach Control	160	70
RADAR		
Approach Control Note 3)	120	90
Departure Control	120	90
Arrival Control	120	90
Final Control (Note 4)	120	40
Coordinator	80	40
Flight Data	80	40
Flight Service Station	60	30

Note 1: Applicable to controllers without previous position qualification at the position under consideration.

Note 2: Applicable to controllers with previous position qualification (any facility) at the position under consideration.

Note 3: Productive training hours for this position are cumulative where more than one such position exists. For example, the approach control position is allocated 120 hours for qualification. If there are three approach control sector positions within the facility, a trainee may be afforded up to 360 hours of approach control training. In cases where two positions, such as departure and arrival control, are included in a single position of operation, the maximum number of hours allowed is the combined total of the hours specified for each.

Note 4: Radar final control qualification may be based on a maximum number of approaches vice PTHs.

traffic control manuals of the FAA and Navy to provide for the safe, orderly, and expeditious flow of air traffic. Also, you must have in your personal possession appropriate CTO/ATCS and Medical certificates. You are required to present these certificates for inspection upon the request of the Administrator or an authorized representative of the National Transportation Safety Board or any Federal, State, or local law enforcement officer.

MAXIMUM HOURS

FAA and military all weather airports normally operate on an around-the-clock

(24 hours a day) basis. You cannot be expected to actively control air traffic and remain alert and safety conscious for a full 24-hour period. Controllers are assigned to rotating watch sections, which allow for relief periods. FAR, Part 65.47 and OPNAVINST 3721.1 prescribe the maximum number of hours that you may control, or be required to control, air traffic, within a specified period of time. However, these maximum hours do not apply in emergency or military necessity situations. These maximums are:

1. During each seven consecutive days, you must be relieved of all duties for at least 24 consecutive hours

2. You may not serve or be required to serve as a controller:

a. For more than 10 consecutive hours or

b. For more than 10 hours during a period of 24 consecutive hours, unless you have had a rest period of at least 8 hours at or before the end of your 10 hours of duty.

EXERCISE

Note: The Exercises throughout this chapter and attendant NRCC assignment are designed to check your understanding of the information presented, as well as your correct interpretation of the FARs. Locate the appropriate section(s) of the FAR excerpts provided in Appendix D of this manual before answering each question.

2-1. In the spaces provided below, list the general eligibility requirements for a CTO certificate.

a. ______________________________

b. ______________________________

c. ______________________________

____

d. ______________________________

____

e. ______________________________

____

2-2. Who has the final authority to issue or revoke CTO certificates issued to Navy control tower operators?

2-3. List three (3) violations addressed in FAR, Part 65 which are grounds for certificate suspension or revocation.

2-4. What is the maximum number of days a temporary CTO certificate can remain effective?

2-5. What are the currency requirements for a CTO facility rating?

2-6. A telegram certificate may be carried as a replacement certificate for a maximum period of how many days?

2-7. What action must you take if there has been a change to your permanent mailing address?

2-8. Each applicant for a facility rating at any air traffic control tower must have satisfactorily served:

a. ______________________________

______________________________, or

b. ______________________________

____

c. ______________________________

____

2-9. Unless you have received additional instructions, how long must you wait before you apply to retake a test that you have failed?

2-10. If you have NOT previously held a CTO certificate, how many productive training hours (maximum) are you allowed to obtain a facility rating at a VFR control tower?

2-11. When, if ever, may a control tower operator issue IFR control instructions?

2-12. When must you have, in your personal possession, appropriate CTO and medical certificates?

2-13. Unless an emergency exists, what are the maximum number of hours that you may serve as a controller in a consecutive 24-hour period?

AIRSPACE

Learning Objective: **Recognize the types of airspace and their vertical limits.**

The Federal Aviation Act of 1958 established the Federal Aviation Administration which is charged by Congress with the safe and efficient use of airspace of the U.S. This includes military aircraft operations, hence the required compliance of Navy ACs with air traffic rules and regulations of the FAA.

Safety, airspace users' needs, and volume of flight operations are some of the factors considered in the designation of the various airspace segments. It is of the utmost importance that you be familiar with the operational requirements for the various airspace segments. This section introduces those operational requirements and terms associated with the various segments of airspace and is compiled from information contained in FARs 71, 73, 75, and 95. Excerpts of these FARs are in Appendix D of this manual.

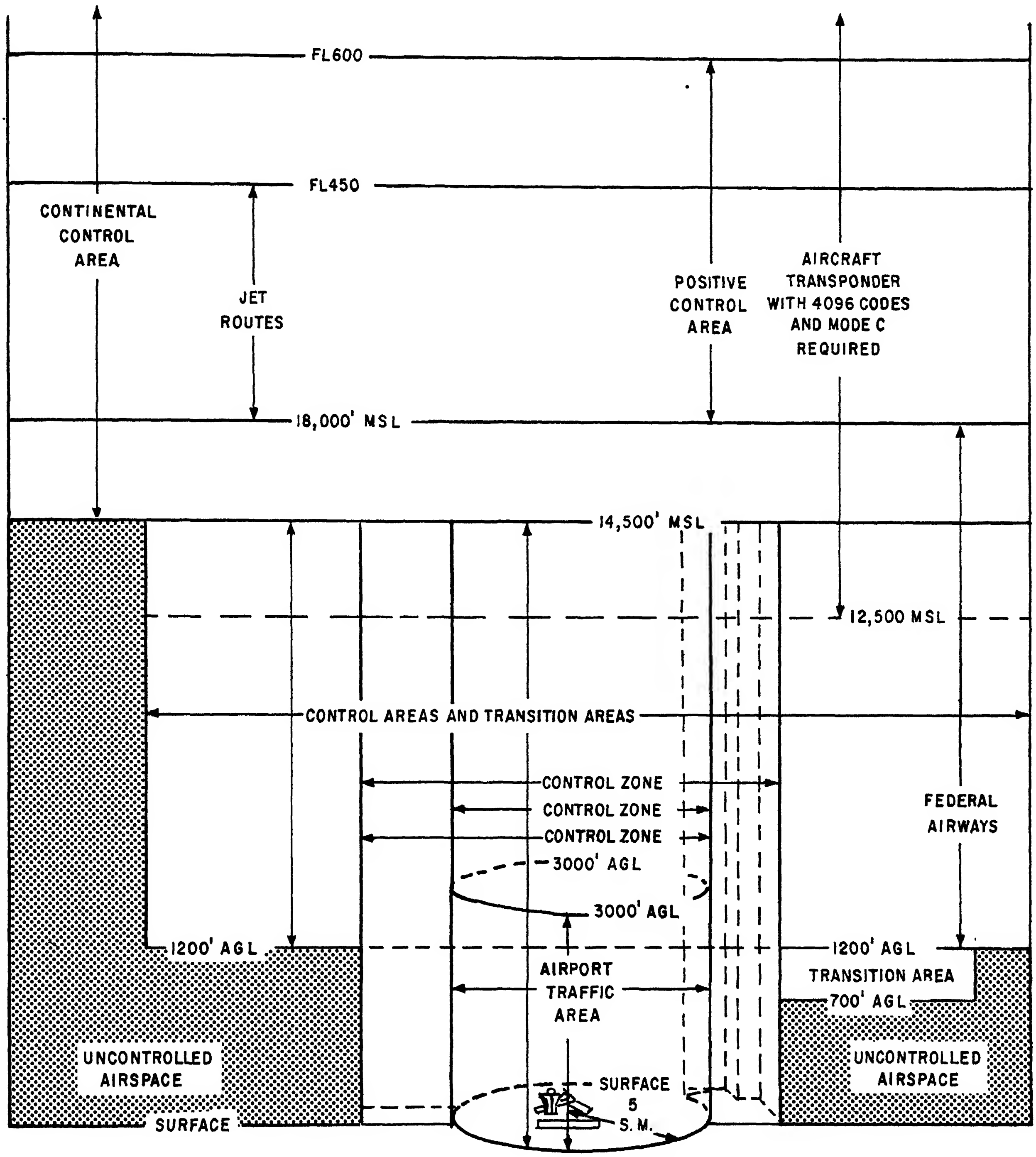
AIRWAYS AND JET ROUTES

Two route systems have been established for air navigational purposes within the contiguous U.S.—the Federal airways system and the jet route system.

Federal Airways

The Federal airways system (as illustrated in figure 2-2) consists of airways designated from not less than 1,200 feet above the ground (AGL) up to, but not including, 18,000 feet above mean sea level (MSL), except that Federal airways over Hawaii have no upper limits. Federal airways are designed to serve aircraft which operate at these levels. Variations of the lower limits or bases of an airway are expressed in hundreds of feet AGL or MSL and, unless otherwise specified, apply to the segment of an airway between adjoining navigational aids or intersections of another airway.

Federal airways are based on a centerline that extends from one navigation aid or intersection of another airway to another navigation aid. Unless otherwise specified, each Federal airway includes the airspace within parallel boundary lines four nautical miles on each side of the centerline. Where an airway changes direction, it includes that airspace enclosed by extending the boundary lines of the airway segments until they meet. Federal airways are shown on charts which are part of the Flight Information Publication



201.121.2

Figure 2-2.—Vertical limits of controlled and uncontrolled airspace.

En Route Low Altitude (FLIP) System, by a "V" and are referred to orally as VICTOR. Example: V12 is spoken VICTOR TWELVE.

Jet Routes

The jet route system consists of routes established from 18,000 feet MSL (flight level 180) to 45,000 feet MSL (flight level 450) inclusive, and are designed to serve aircraft which operate at these levels. They are identified by the letter "J" on En Route High Altitude Charts and referred to orally by statement of the letter "J". Example: J12 is spoken JAY TWELVE.

The airspace structure above FL 450 is designed to permit free selection of routes. Navigation is conducted by NAVAIDS serving the jet route system provided the aids are not more than 200 miles apart.

CONTROLLED AIRSPACE

Controlled airspace consists of those areas designated as Continental Control Area, Control Area, Control Zones, Terminal Control Areas, and Transition Areas, within which some or all aircraft may be subject to Air Traffic Control. When so designated, the airspace is supported by ground-to-air communications, navigation aids, and air traffic services.

Continental Control Area (CCA)

The Continental Control Area consists of the airspace of the 48 contiguous states, the District of Columbia, and Alaska, at and above 14,500 feet above mean sea level (MSL), but does not include:

1. The airspace less than 1,500 feet above the surface of the earth (AGL).
2. Prohibited and restricted areas, other than the restricted areas listed in FAR 71, subpart D.
3. The Alaska Peninsula west of longitude 160° 00′ 00″ W. (See figure 2-2.)

NOTE: Arrows ending near, but not touching, reference lines mean up to or down to, but not including, the referenced altitude.

Control Areas

Control areas consists of the airspace designated as Colored Federal airways, Additional Control Areas, and Control Area Extensions, but do not include the Continental Control Area. Unless otherwise designated, control areas also include the airspace between a segment of a main VOR federal airway and its associated alternate segments. The vertical extent of the various categories of airspace (at whatever altitudes they begin and end) contained in control areas is defined in FAR 71 and normally begins at 1,200 AGL. (See figure 2-2.)

Positive Control Area (PCA)

Positive control area is that airspace wherein aircraft are required to be operated under Instrument Flight Rules (IFR). Positive control airspace is depicted on En Route High Altitude Charts. For operations within the PCA, aircraft must be:

1. Operated under IFR at a specified flight level or altitude assigned by ATC.
2. Equipped with instruments and equipment required for IFR operations and flown by a pilot rated (certified) for instrument flight.
3. Equipped with a coded radar beacon transponder, having a Mode A (military Mode 3) capability, replying to Mode 3/A interrogation with the code specified by ATC.

NOTE: Radar beacon transponders are covered in Chapter 12 Radar Principles and Allied Equipment.

4. Equipped with automatic pressure altitude reporting equipment having a Mode C capability that automatically replies to Mode C interrogations by transmitting pressure altitude information in 100-foot increments.
5. Radio equipped to provide direct pilot/controller communication on the frequency specified by ATC for the area concerned.

ATC may authorize deviations from the above requirements for operation in a positive control area. The vertical extent of PCA is from 18,000 feet MSL to FL600 (60,000 feet MSL). (See figure 2-2.)

Control Zones

A control zone is controlled airspace which extends upward from the surface of the earth and terminates at the base of the continental control area. Control zones that do not underlie the continental control area have no upper limit. It may include one or more airports and is normally a circular area with a radius of five statute miles on an airport and any extensions necessary to include instrument departure and arrival paths.

Transition Areas

A transition area is controlled airspace extending upward from 700 feet or more above the surface of the earth when designated in conjunction with an airport for which an approved instrument approach procedure has been prescribed; or from 1,200 feet or more above the surface of the earth when designated in conjunction with airway route structures or segments. Unless specified otherwise, transition areas terminate at the base of overlying controlled airspace.

Transition areas are designated to contain IFR operations in controlled airspace during portions of the terminal operation and while transitioning between the terminal and en route environment.

Terminal Control Areas (TCA)

A Terminal Control Area (TCA) consists of controlled airspace extending upward from the surface of the earth or higher to specified altitudes within which all aircraft are subject to operating rules and pilot and equipment requirements specified in Part 91 of the FARs. TCAs are described in Part 71 of the FARs.

Each such location is designated as a Group I, Group II, or Group III Terminal Control Area, and includes at least one primary airport around which the TCA is located.

Group I terminal control areas represent some of the busiest locations in terms of aircraft operations and passengers carried. It is necessary for safety reasons to have stricter requirements for operation within Group I TCAs. The newer Mode 3A and automatic altitude reporting equipment and an air traffic control clearance are required for operation in these TCAs.

Group II terminal control areas represent less busy locations, and though safety dictates some pilot and equipment requirements, they are not as stringent as those for Group I locations.

Unlike Groups I and II TCAs, in Group III TCAs, the new equipment is not required if two-way radio communications are maintained within the TCA between the aircraft and the ATC facility, and the pilot provides position, altitude, and proposed flight path prior to entry into the TCA.

SPECIAL USE AIRSPACE

Special use airspace consists of that airspace wherein activities must be confined because of their nature, or wherein limitations are imposed upon aircraft operations that are not a part of those activities, or both. The vertical and horizontal limits of special use airspace and its time of operation are clearly defined. These areas along with their periods of operation are depicted on aeronautical charts.

Prohibited Areas

Prohibited areas contain airspace of defined dimensions identified by an area on the surface of the earth within which the flight of aircraft is prohibited. Such areas are established for security or other reasons associated with the national welfare.

An example of a prohibited area is the area that encompasses the White House and the Capitol buildings in Washington, D.C. This area is identified on charts and carries the designation of P-56. Aircraft operations are prohibited in P-56 from the surface up to 18,000 feet MSL. Another example is P-205, located southeast of International Falls, Minnesota. It extends from the surface to 4,000 feet, and contains part of the Superior National Forest. This prohibited area was established to safeguard the forest and wildlife in one of the few remaining wilderness areas in the U.S.

Restricted Areas

Restricted areas contain airspace identified by an area on the surface of the earth within which the flight of aircraft, while not completely

prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature or limitations imposed upon aircraft operations that are not a part of those activities or both. Restricted areas denote the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Penetration of restricted areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants.

The using agency of a restricted area is the agency, organization, or military command whose activity within the restricted area necessitated the area being so designated. The controlling agency is the FAA facility that may authorize transit through or flight within the restricted area in accordance with a joint-use letter of agreement between the using agency and the FAA.

Warning Areas

Warning areas are airspaces which may contain hazards to nonparticipating aircraft in international airspace over open waters. Though the activities conducted within Warning Areas may be as hazardous as those in Restricted Areas, Warning Areas cannot be legally designated as Restricted Areas because they are over international waters. Penetration of Warning Areas during periods of operation may be hazardous to the aircraft and its occupants.

Alert Areas

Alert areas contain airspace which is depicted on aeronautical charts to inform nonparticipating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. These are areas in which pilots should be particularly alert. All activity within an alert area shall be conducted in accordance with Federal Aviation Regulations without waiver, and pilots of participating aircraft as well as pilots transiting the area shall be equally responsible for collision avoidance.

Airport Traffic Areas (ATA)

Unless otherwise specifically designated ATAs include that airspace within a horizontal radius of five statute miles from the geographical center of any airport at which a control tower is operating, extending from the surface up to, but not including, an altitude of 3,000 feet above the elevation of the airport.

Airport Advisory Areas (AAA)

An AAA is that area within ten statute miles of an airport where a control tower is not operating but where a Flight Service Station (FSS) is located. At such locations, the FSS provides advisory service to arriving and departing aircraft.

It is not mandatory that pilots participate in the airport advisory service program, but it is strongly recommended.

Military Operations Areas (MOA)

Military Operations Areas consist of airspace, defined by altitude and geographic location, established for the purpose of separating certain military training activities from IFR air traffic. Whenever a MOA is being used, nonparticipating IFR traffic may be cleared through an MOA if IFR separation can be provided by air traffic control authority. Otherwise, the control facility must reroute or restrict the nonparticipating aircraft.

Military Training Routes (MTR)

National security depends largely on the deterrent effect of our airborne military forces. To be proficient, the military services must train in a wide range of airborne tactics. One phase of this training involves "low level" combat tactics. The required maneuvers and high speeds are such that they may occasionally make the see-and-avoid aspect of VFR (Visual Flight Rules) flight more difficult without increased vigilance. In an effort to ensure the greatest practical level of safety for all flight operations, the Military Training Route (MTR) program was conceived.

The MTR program is a joint Department of Defense and FAA venture. Generally, MTRs are established below 10,000 feet MSL at speeds in excess of 250 knots. The routes above 1,500 feet AGL are developed to be flown, to the maximum extent possible, under IFR conditions. The routes at 1,500 feet AGL and below are generally developed to be flown under VFR conditions.

UNCONTROLLED AIRSPACE

Uncontrolled airspace is that portion of airspace within which Air Traffic Control does not have the authority nor the responsibility to exercise control over air traffic.

Rules governing VFR flight in uncontrolled airspace have been adopted to assist pilots in meeting their responsibility to see and avoid other aircraft. These rules and the minimum weather conditions and distance from clouds required for VFR flight are discussed later in this chapter.

EXERCISE

2-14. What are the (a) lower and (b) upper limits of a Federal airway?

2-15. What is the normal width of a Federal airway?

2-16. How are Federal airways identified on aeronautical charts?

2-17. What are the vertical limits of jet routes and how are they identified on en route charts?

2-18. In your own words, what is the basic difference between controlled airspace and uncontrolled airspace?

2-19. For each of the following areas, identify them as controlled airspace, uncontrolled airspace, or special use airspace.

a. MOA (Military Operations Areas).

b. Airspace over the U.S. which is 1,500 feet MSL above a 300-foot MSL surface.

c. Airspace over the U.S. which is 1,500 feet AGL above a 300-foot MSL surface.

d. CCA (Continental Control Area).

e. Group III TCA

2-20. What are the basic differences between a Restricted Area (RA) and a Warning Area (WA)?

GENERAL OPERATING AND FLIGHT RULES

FAR, Part 91, prescribes the basic flight regulations governing the operation of aircraft within the United States. Any agency concerned with the operation of aircraft, such as the armed forces and air carrier companies, may write regulations applicable to its own operations. However, such regulations must not be less restrictive than the minimum requirements set forth in Part 91. Navy pilots must also comply with OPNAVINST 3710.7 (General Flight and Operating Instructions) which supplements FAR, Part 91.

The majority of military flight directives are patterned after FARs. Deviations from established Federal regulations, which have been authorized or prescribed for Navy pilots, are covered in each applicable section.

Flight rules are divided into three major categories: General Flight Rules (GFRs), Visual Flight Rules (VFRs), and Instrument Flight Rules (IFRs). General flight rules apply to all aircraft operations. Visual flight rules are additional rules governing the operation of aircraft in weather conditions that permit the pilot to see-and-avoid other aircraft. Instrument flight rules are also additional to general flight rules. However, IFR rules regulate the flight of aircraft in weather conditions that do not permit VFR flight. While operating aircraft in the United States, pilots must adhere to general flight rules and applicable portions of visual flight rules and/or instrument flight rules.

Over the high seas, aircraft (military and civilian) of United States registry must comply with still another set of rules. These rules, Annex 2 of the International Civil Aviation Organization (ICAO), are international in nature. Most countries of the free world comply with the procedures contained in Annex 2.

GENERAL FLIGHT RULES (GFR)

Learning Objective: **Recognize those general flight rules that govern the operation of aircraft as prescribed in FAR, Part 91 and OPNAVINST 3710.7**

The most commonly used flying regulations are referred to as general flight rules. Both FAA and military directives begin by presenting general flight rules and requirements that apply to the operation of an aircraft in the air and on the ground. OPNAVINST 3710.7 has, in some cases, placed higher restrictions on the operation of Navy aircraft than have been placed by the FAA on civil aircraft, however, for the most part, it is patterned after civil directives.

An aircraft must be operated at all times in compliance with general flight rules and also either visual or instrument flight rules, whichever is applicable.

Responsibility and Authority of the Pilot in Command

Just as we have some established and recognized general rules for driving automobiles—such as not passing on hills or on blind curves—we have rules for the safety of aircraft. We all know that our highway laws strictly prohibit careless or reckless driving. Careless or reckless flying, of course, is similarly prohibited. No pilot may fly an aircraft in such a way that it endangers the life or property of any person. Examples of such operations are "buzzing" or diving on a farm, home, automobile, ship, livestock, or person; low-altitude flights that endanger the aircraft passengers or endanger persons or property on the ground; and passing other aircraft too closely.

The pilot in command of an aircraft is directly responsible for, and is the final authority for, the operation of that aircraft. This responsibility begins with preflight action for each flight. The pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight. This information includes, but is not limited to:

1. Weather reports and forecasts
2. Fuel requirements
3. Alternate airports, if required
4. Runway lengths and available airport services
5. NOTAMs
6. Any known traffic delays.

Right-of-Way Rules

Every state has established right-of-way rules for automobiles, such as those rules used at major intersections and traffic hubs. Similar rules have been established for aircraft. Whenever weather conditions permit, regardless of whether an operation is conducted under Instrument Flight Rules or Visual Flight Rules, vigilance must be

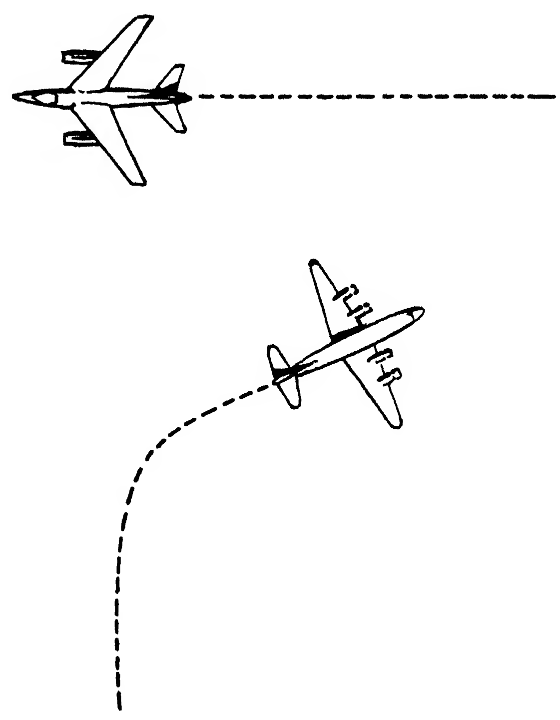


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Figure 2-3.—Converging aircraft.

maintained by each person operating an aircraft so as to see-and-avoid other aircraft. The pilot of an aircraft must not pass over, under, or ahead of another aircraft, unless he or she can pass well clear of it.

FAR, Part 91, and OPNAVINST 3721.1 make it very clear who has the right-of-way. The following discussion describes five situations in which pilots are likely to become involved with right-of-way rules:

1. Distress—An aircraft in distress has the right-of-way over all other air traffic.

2. Converging—Converging aircraft have priority in the following order: (1) balloons, (2) gliders, (3) aircraft towing or refueling other aircraft, (4) airships (blimps), and (5) rotorcraft/fixed wing aircraft. These priorities are similar to those used for ships in that the least maneuverable always has the right-of-way. If two or more aircraft of the same category are converging at approximately the same altitude, the aircraft on the right has the right-of-way. (See figure 2-3.)

3. Approaching head on—When two aircraft are approaching head on, or approximately so, each pilot should alter their course to the right. (See figure 2-4.)

4. Overtaking—An aircraft that is being overtaken has the right-of-way. The aircraft that is doing the overtaking—whether climbing, descending, or in level flight—should alter its

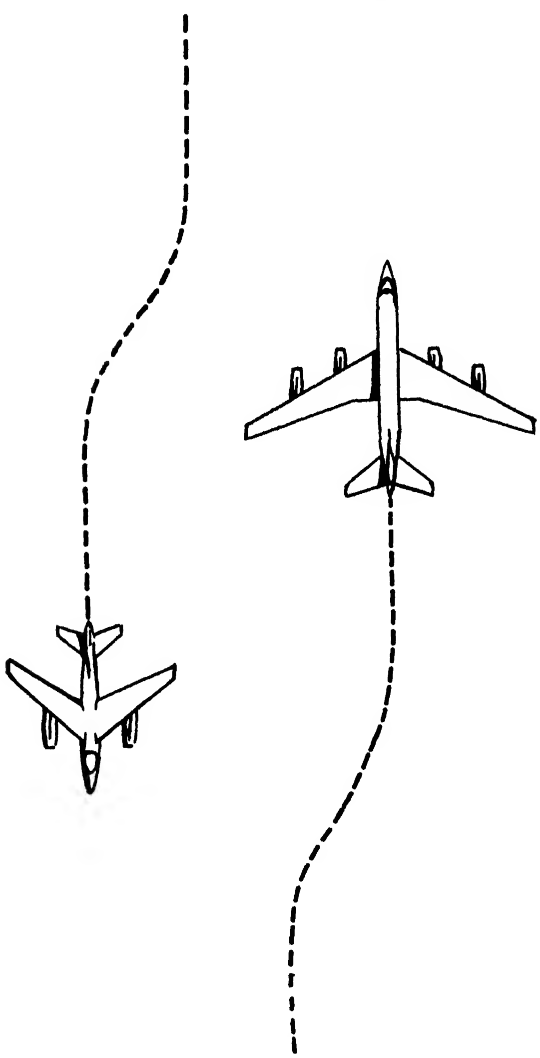

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Figure 2-4.—Aircraft approaching head-on.

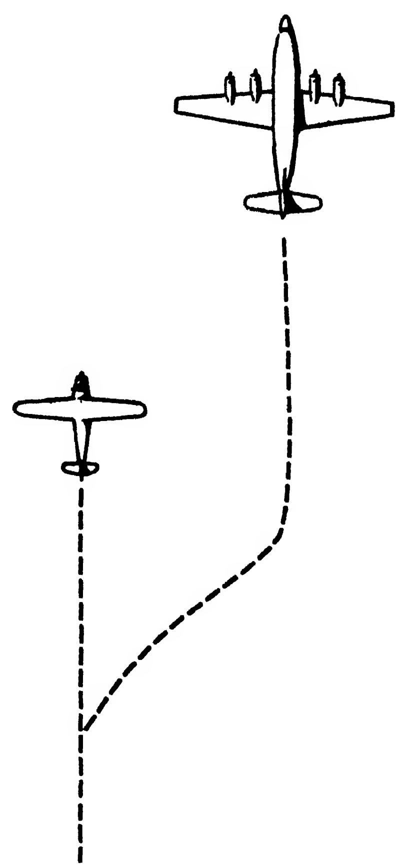

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Figure 2-5.—Aircraft overtaking another.

course to the right and thus avoid the other aircraft. (See figure 2-5.) The aircraft doing the passing is responsible for avoiding a collision.

5. Landing—An aircraft on final approach or an aircraft in the process of landing has the right-of-way over other aircraft in flight or operating on the surface. When two or more aircraft are approaching for a landing, the aircraft at the lower altitude has the right-of-way.

In addition to the five right-of-way rules above, Navy pilots have another rule to follow. When a single naval aircraft is converging with a formation of aircraft at approximately the same altitude (except head-on, or nearly so) the formation flight has the right-of-way. In other cases, the formation is considered as a single aircraft and the right-of-way rules above apply.

One point must be made here, although it is NOT a right-of-way rule. In the interest of fuel consumption, OPNAVINST 3710.7 authorizes Navy pilots to request, and Navy Control Tower personnel to grant whenever feasible, priority for taxi, takeoff, or landing of jet aircraft when such priority is considered necessary. However, this priority should not be granted when a landing jet aircraft or any hospital evacuation aircraft is involved.

Proximity of Aircraft

No pilot may operate an aircraft so close to another aircraft as to create a collision hazard. Military pilots must maintain approximately 500 feet vertically or one mile laterally (well clear) separation as a guide unless flying in formation flight. Additionally, no pilot may attempt to fly an aircraft in formation with another aircraft, except by prearrangement with the pilot of the other aircraft. Aircraft engaged in command approved maneuvers, such as interceptor attack training are also excused from the aircraft proximity rule. In each exception (formation flight or command approved maneuvers), each pilot must be aware of the other's presence and qualified to conduct the operation safely.

Aerobatic Flight

For the purpose of our discussion, we refer to aerobatics (acrobatic flight) as those aircraft maneuvers, not necessary for normal flight, which involve the following actions:

1. An abrupt change in an aircraft's attitude
2. Intentionally performed spins or other maneuvers requiring pitch/dive angles greater than 45 degrees
3. Turns with bank angles greater than 60 degrees
4. Accelerations greater than 2.0 g (two times the normal force of gravity).

Pilots may not engage in aerobatic flight over congested areas (cities, settlements); open-air-assemblies; within any Federal airway or control zone; or at an altitude below 1,500 feet above the surface, or when flight visibility is less than three (3) miles.

The Navy does not desire to discourage or curtail aerobatic training. However, it is of the utmost importance that such training be well regulated as to time, place, and conditions which enhance safety of flight. Pilots, when performing an aerobatic maneuver, must remain in VFR weather conditions. Navy pilots are encouraged to conduct aerobatic training in designated aerobatic areas. Additionally, they must remain at an altitude of at least 1,500 feet above the highest obstruction to flight or cloud tops within a horizontal distance of five miles. These various restrictions allow pilots to see other aircraft soon enough to avoid a collision and provide them with sufficient altitude to safely recover from aerobatic maneuvers.

Flight demonstration teams such as the Navy's Blue Angels and other groups, must obtain a Certificate of Waiver from the FAA prior to their performances.

Aircraft Speed

In order to reduce the midair collision hazard associated with high aircraft speeds at low altitudes, FAR 91 imposes a maximum airspeed limitation of 250 knots indicated airspeed (KIAS) on all aircraft operating below 10,000 feet MSL in airspace where FAR 91 applies. Also, FAR 91 imposes a maximum airspeed of 200 KIAS for aircraft operating in airspace beneath the lateral limits of any Terminal Control Area (TCA). The

regulation grants exception for operations that cannot safely be conducted at airspeeds less than the prescribed maximum airspeed. For example, the FAA has authorized the Department of Defense (DOD) to exceed 250 KIAS below 10,000 feet MSL for certain military requirements, such as operations within restricted areas or military operations areas. Additionally, if the airspeed required or recommended in the aircraft Naval Air Training and Operations Procedures Standardization (NATOPS) manual to maintain safe maneuverability is greater than the maximum speeds above, the aircraft may be operated at that speed. However, the pilot must notify the Air Traffic Control Facility of that higher speed.

Aircraft Lighting

Between sunset and sunrise—30 minutes before official sunset until 30 minutes after official sunrise—or at any time when the prevailing visibility as seen from the cockpit is less than three statute miles, standard aircraft position lights must be illuminated. The location and color of standard aircraft position lights are shown in figure 2-6. Position lights are turned on immediately before engine(s) start(s) and remain(s) operational until engine(s) shutdown. When the aircraft is equipped with an anticollision light, as shown in figure 2-6, the anticollision light must be lighted at all times when the aircraft's engine(s) is/are in operation except when the use of such lights adversely affects ground operations or in the interest of safety. For example, the anticollision light may be turned off during flight through clouds when the rotating light reflects into the cockpit. Airborne tankers, used for inflight refueling, normally have a green anticollision light for identification purposes.

Additionally, between sunset and sunrise, position lights on parked aircraft and on aircraft being towed are required to be operational unless the aircraft is clearly illuminated by other lighting. This lighting rule, however, applies only when such aircraft create a potential hazard to other operations.

To the extent necessary for safety, lighting configuration for formation flights may be varied according to aircraft model and mission requirements. Normally, all aircraft in the flight shall have external lights on and at least one aircraft in the flight shall have position lights on bright and the anticollision light on when aircraft lighting is required.

The use of landing/taxi lights is an effective means of illuminating surface hazards during taxi

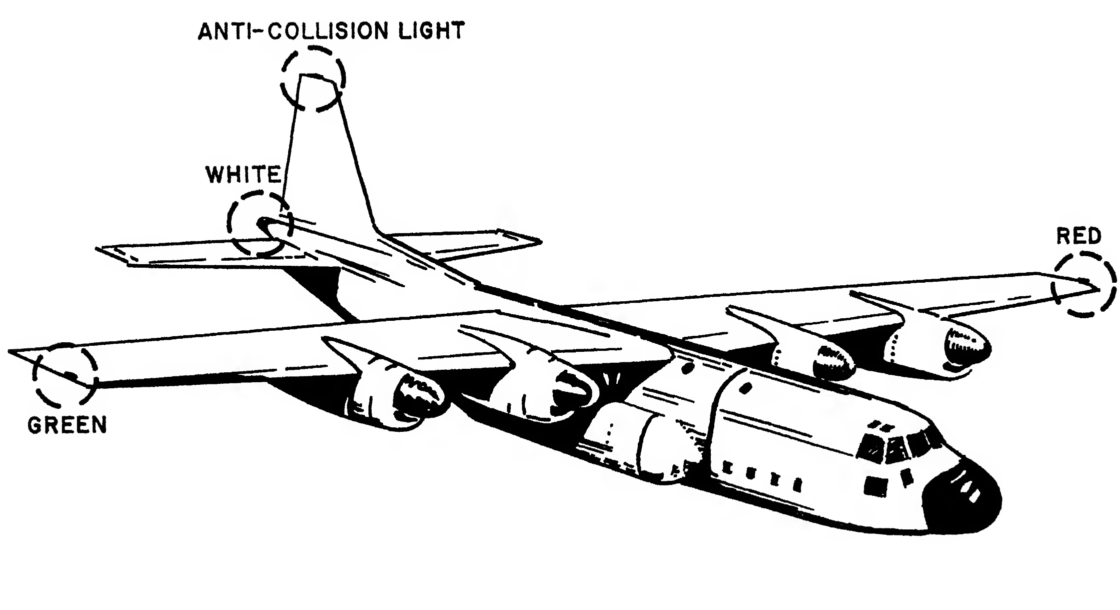

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Figure 2-6.—Aircraft position lights.

movements at night and alerting all concerned of an aircraft's presence/position in flight. Accordingly, Navy pilots are encouraged to use landing/taxi lights for all taxi movements ashore during the hours of darkness unless the aircraft is being directed by a taxi signalman. Additionally, the use of these lights during landing approaches (both day and night) within the airport traffic area is recommended when meteorological conditions permit.

Minimum Safe Altitudes

Pilots in flight must maintain certain altitudes so that lives and property are protected. The following discussion states the altitudes pilots must maintain over various areas. These restrictions naturally do not apply to the landing and takeoff phases of flight.

ANYWHERE.—An aircraft must be flown at an altitude that permits the pilot, in the event of power failure, to make an emergency landing without undue danger to persons or property. (See figure 2-7).

OVER CONGESTED AREAS.—Over congested areas of a city, town, or settlement, or over any open air assembly of persons, an aircraft must be flown at an altitude of at least 1,000 feet over the highest obstacle within a horizontal radius of 2,000 feet from the aircraft. (See figure 2-8.) Helicopters may be flown at less than these minimums if the flight does not endanger persons or property. In the interest of safety, the Administrator or local military commanders may establish special routes for helicopters.

OVER OTHER THAN CONGESTED AREAS.—An aircraft must maintain an altitude of 500 feet above the surface, except over open water or sparsely populated areas. The aircraft must never be flown nearer than 500 feet to any person, vessel, or structure. (See figure 2-9.)

WITHIN A DESIGNATED DISASTER AREA.—A disaster area consists of the airspace designated as such, with reference to geographic boundaries and altitudes, by a NOTAM issued at the direction of the FAA Administrator. This is

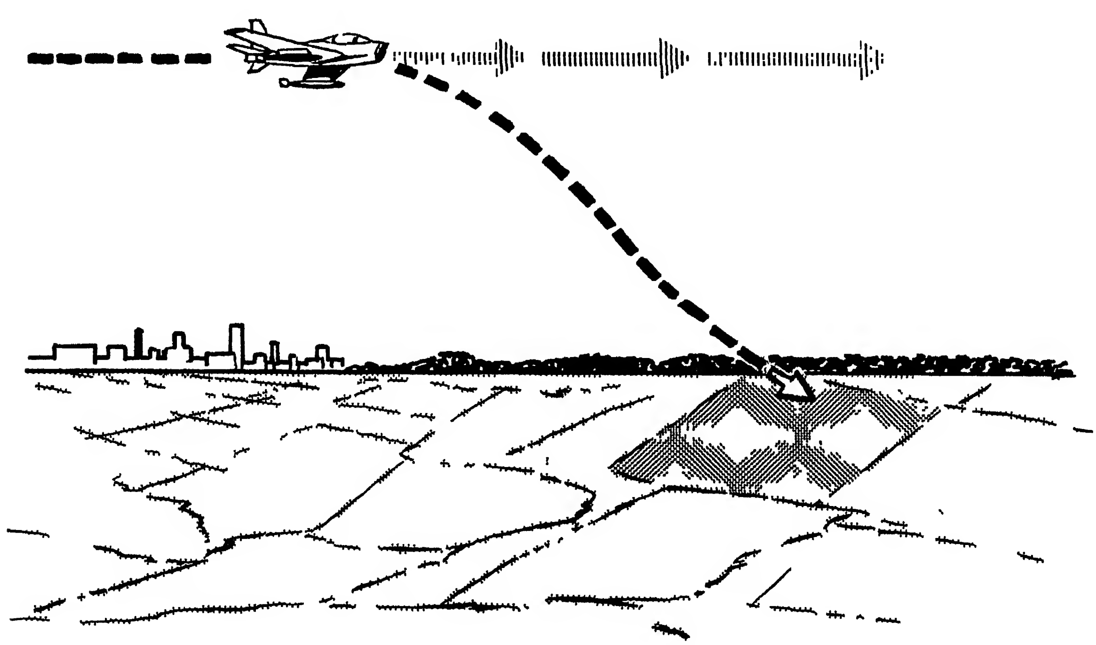

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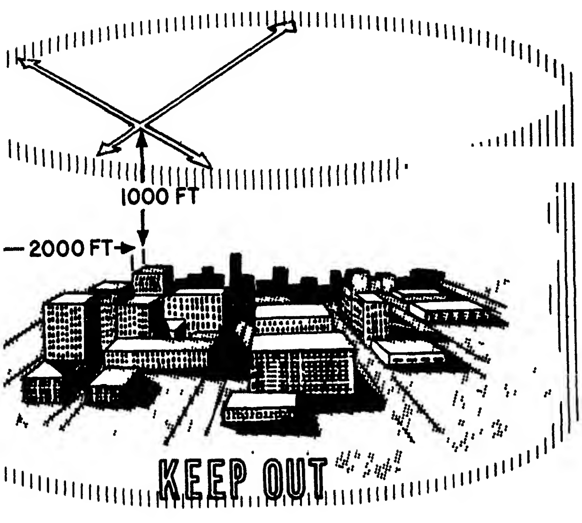
Figure 2-7.—Minimum safe altitudes—anywhere.

e to prevent the concentration of large ıbers of sightseeing aircraft above the scene a natural disaster or an accident of such ;nitude that it attracts widespread public rest. Navy aircraft may not be flown in a designated disaster area unless they are (1) participating in airborne relief activities; (2) being operated to or from an airport within the disaster area in a manner that does not interfere with, nor endanger, relief activities; or (3) following instructions received in an ATC clearance.



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re 2-8.—Minimum safe altitudes over congested areas.

OVER NOISE SENSITIVE AREAS.—As stated earlier, OPNAVINST 3710.7 supplements Part 91. This instruction requires Navy pilots to conduct their flights in such a manner that a minimum of annoyance is experienced by persons and activities on the ground. Navy pilots must take definite and particular pains to satisfy themselves that they are flying in such a manner that no person could reasonably think that their life or property is endangered.

Breeding farms, wildlife feeding grounds, resorts, beaches, and those areas designated by the U.S. Department of Interior as National Parks, National Monuments, and National Recreational Areas are examples of noise sensitive areas. Navy pilots shall avoid these areas by one mile when at altitudes of less than 3,000 feet above the surface.

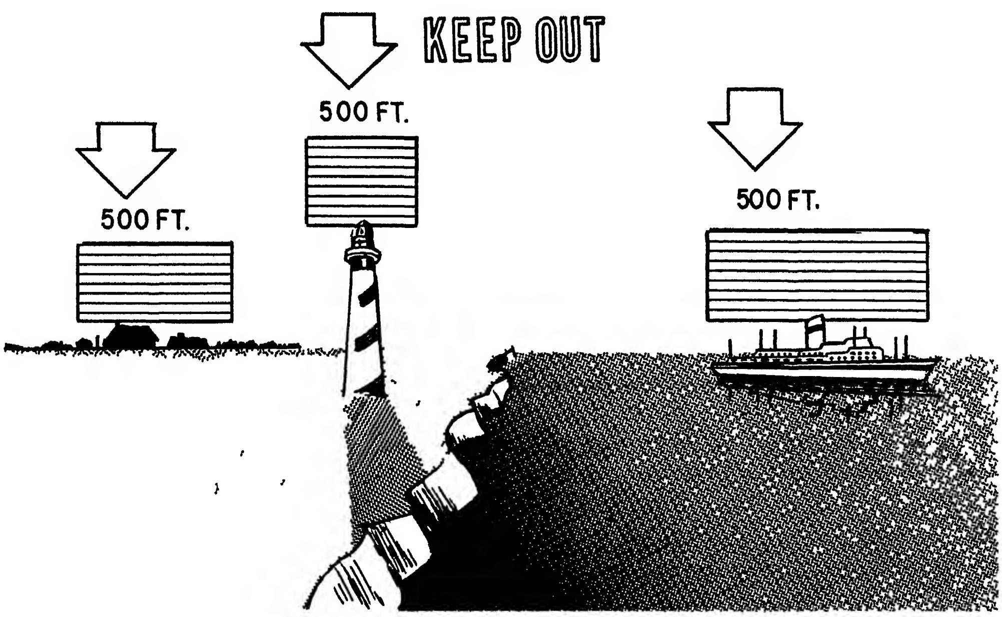

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Figure 2-9.—Minimum safe altitudes over other than congested areas.

Altimeter Settings

Pilots are required to maintain their aircraft's cruising altitude or flight level (FL), as the case may be, by reference to an altimeter that is set as follows:

1. When operating below 18,000 MSL, to the current reported altimeter setting for a station along the route of flight and within 100 nautical miles of the aircraft. If there is no station within the area prescribed above than to the current altimeter setting of an appropriate available station. If the aircraft is not radio-equipped, the pilot must use the altimeter setting for the departure airport.
2. At or above 18,000 MSL, all altimeters must be set to 29.92 inches.

NOTE: Altimeter settings are a measurement of atmospheric pressure. Altimeter settings and indicators are discussed elsewhere in this course.

Deviation from Part 91 Rules

The rules in Part 91 of the Federal Aviation Regulations apply to pilots operating aircraft anywhere in the United States, its territories, and its possessions. This includes the territorial waters and the overlying airspace of these areas. We use overlying airspace here to mean the airspace extending from the surface up to the maximum altitude limits of aircraft. There are some exceptions which allow pilots to deviate from these rules: (1) in an emergency, (2) when a military necessity exists, or (3) when the FAA Administrator grants a waiver of these rules. Let us take a closer look at these exceptions.

In an emergency requiring immediate action, the pilot in command may deviate from any rule to the extent required to meet that emergency. However, the pilot must, upon the request of the Administrator, make a written report of the deviation.

Some of our military pilots have the responsibility of defending our country. There are times when a fighter pilot may need to fly his aircraft in a way that conflicts with the rules of Part 91. On these occasions, there may not be enough time for military authorities to request a waiver of the rules. Therefore, the pilot may deviate from Part 91 when military authorities determine that a military necessity exists. A military necessity might be the interception of an unknown aircraft by an air defense pilot who must identify the aircraft as friendly or hostile.

Another case when deviation from Part 91 may be allowed is when military or civilian pilots are engaged in special flight operations that necessarily conflict with the regulations. Air shows, air races, aerobatic flights, seeding operations, and crop dusting are examples of special flight operations. In all of these cases, however, the pilot must obtain a waiver before deviating from the rules. The Administrator may issue a Certificate of Waiver authorizing the operation of aircraft in deviation of any rule set forth in Part 91 if it is determined that the operation can be safely conducted. Applications for a Certificate of Waiver may be submitted to any FAA office.

Compliance with ATC Clearances and Instructions

An ATC clearance is issued for the purpose of preventing collision between known and controlled IFR aircraft and does not constitute authority for a pilot to violate any provision of the Federal Aviation Regulations. The pilot is still the final authority where the operation of his or her aircraft is concerned and may, therefore, in an emergency deviate from either an ATC clearance or instruction. To confirm this, Part 91.75 of the FARs states: ". . . (b) Except in an emergency, no person may, in an area in which air traffic control is exercised, operate an aircraft contrary to an ATC instruction; (c) Each pilot in command who deviates, in an emergency, from an ATC clearance or instruction shall notify ATC of that deviation as soon as possible." If the deviation was the result of an emergency situation that required air traffic control priority, the pilot must, if requested by ATC, submit a detailed report of the emergency to that ATC facility within the next 48 hours.

An alleged violation of flying regulations by Navy pilots falls within the purview of U.S. Navy Regulations. Therefore, the accomplishment of the required investigation and following reports are the responsibility of the commanding officer of the pilot concerned. The procedures for

investigating and reporting flight violations are contained in OPNAVINSTs 3710.7 and 3760.1.

Airport Operations

Unless otherwise authorized or required by ATC, no person may operate an aircraft within an airport traffic area except for the purpose of landing at or taking off from, an airport within that area. In addition, the following rules must be complied with:

GENERAL.—Aircraft operating to, from, or on an airport with an operating control tower must comply with instructions received from that control tower or other ATC facility having control jurisdiction.

COMMUNICATIONS.—The pilot must establish and maintain two-way radio communications with the ATC facility and monitor emergency frequencies. If radio communications fail in flight, a landing may be made if weather conditions are at or above basic VFR weather minimums (cloud ceiling 1,000 feet or higher and visibility at least three miles). The pilot must be able to maintain visual contact with the ground and receive the appropriate light-gun signal.

NOTE: Light-gun signals are covered in Chapter 10.

MINIMUM ALTITUDES.—Unless otherwise required by local procedures, ATC instructions, or by an applicable distance from cloud criteria, turbine-powered aircraft or a large aircraft must enter the airport traffic area at an altitude of at least 1,500 AGL. They are also required to maintain at least 1,500 AGL until further descent is required for a safe landing.

NOTE: Pattern altitude for propeller and small aircraft is normally 1,000 AGL.

When a large or turbine-powered aircraft departs, it is required to climb to an altitude of 1,500 feet AGL as rapidly as practicable.

TRAFFIC PATTERNS.—At airfields with an operating control tower, all traffic circles the runway to the left, unless the pilot is instructed otherwise. At airfields without an operating control tower, all traffic circles the runway to the left, unless the airport displays approved light signals or visual markings indicating that turns should be made to the right. Helicopters are to avoid the flow of fixed wing aircraft and must not exceed 500 feet AGL (above ground level), within an airport traffic area, unless specifically cleared by the control tower.

TAXI, TAKEOFF, AND LANDING.—A clearance must be requested and received before an aircraft may taxi, take off, or land. When the tower issues taxi clearance for an aircraft to proceed to a specific runway, the pilot must obtain another clearance to taxi onto that runway. However, unless stated otherwise in the taxi clearance, that clearance does grant approval for the pilot to cross all other intersecting runways to reach the specified runway. Upon landing, a pilot may not turn around on the runway and taxi against oncoming traffic unless specific approval is obtained from the control tower.

Navy pilots must read back all "hold/hold short" instructions received during taxiing. Additionally, no taxiing aircraft shall overtake or pass another aircraft except with tower approval. All aircraft shall be taxied at a safe rate of speed and under the positive control of the pilot at all times.

When the tower is controlling an aircraft in an emergency, aircraft on the ground must taxi clear of the runway. Those on the taxiway shall hold until authorized to proceed. All aircraft shall exercise radio discipline for the duration of the emergency. Pilots of taxiing aircraft sighting emergency vehicles on the field displaying the flashing red light, shall stop and hold their positions until authorized by radio or by light signals from the tower to proceed.

Additional GFRs

The Navy has adopted some additional GFRs to cover the operation of its aircraft. The following GFRs are contained in OPNAVINST 3710.7 and deal more specifically with USN procedures than with civil; however, you do find a common bond between them in most areas. We make no attempt here to identify exceptions or differences but deal strictly with military policy.

AIRPORT TRAFFIC AREA.—OPNAVINST 3710.7 states "Navy pilots shall not perform or request clearance to perform unusual maneuvers within an airport traffic area if such maneuvers are not essential to the performance of the flight". Additionally, Navy air traffic controllers are not permitted to approve a pilot's request or ask a pilot to perform these maneuvers. Unusual maneuvers include unnecessary low passes, unscheduled fly-bys, climbs at very steep angles, practice approaches to altitudes below specified minima (unless a landing is to be made), or any so-called "flat hatting" wherein a flight is conducted at a low altitude and/or a high rate of speed for thrill purposes.

SIMULATED FLIGHT OPERATIONS.—Simulation, or the practice of procedures, is a very necessary thing, and controllers should always be alert for a pilot's request to perform simulated operations. The two most common simulated operations are (1) instrument (hooded) flight and (2) emergencies. Both of these are covered by GFRs.

Simulated Instrument Flight.—Pilots conducting simulated instrument flights sometimes use a hood which restricts a pilot's view to the aircraft's instruments. This procedure is especially unsafe in VFR weather because the pilot cannot see outside the aircraft's cockpit; thus, the following GFRs must be complied with:

1. Approval is obtained from the appropriate facility before conducting simulated instrument approaches.

2. An adequate cockpit visual lookout is maintained during the flight, either by qualified crewmen who have positive communications with the pilot and are able to clear the aircraft from potential midair collision hazards, or a chase plane. In the case of a chase plane, the chase plane should fly in a position 500 feet behind and 500 feet to either side of the aircraft being chased, so as to ensure clearance in all quadrants. Again, positive communications must be maintained at all times between the two aircraft and any controlling agency.

3. Navy pilots of single-piloted aircraft may not use a hood below 1,000 feet AGL except when making a precision approach. When making a precision approach, either radar or other similar NAVAID, these pilots may use a vision-restricting device down to 500 feet AGL. In multi-piloted aircraft, a hood may be used by one pilot for simulated instrument takeoffs and down to published minimums for the approach being flown, provided the other pilot is qualified in the aircraft being flown.

Simulated Emergency Flight.—The need for pilots to practice inflight emergencies should be obvious. Cooperate with them the best you can when they request to conduct practice emergency operations. Some pilot GFRs which cover these operations are:

1. Not to practice emergency procedures when passengers are on board.

2. Not to practice emergency procedures during IFR or marginal VFR weather.

3. Not to fully feather or secure an engine below 4,000 AGL. Note: Four-engine Navy aircraft may, at times, have to be checkflighted with one engine secured. This is authorized provided it is done at altitudes of 1,500 feet AGL or higher subject to restrictions.

4. Simulated flameout [complete shutdown of engine(s)] approaches are PROHIBITED for Navy aircraft.

EXERCISE

2-21. Pilots of naval aircraft must abide by how many sets of flight rules?

2-22. Who has the direct responsibility for the operation of an aircraft?

For exercise 2-23, apply an appropriate right-of-way rule to each of the following situations, i.e., which aircraft has the right-of-way?

2-23. (a) One aircraft is on short final approach and another is ready for takeoff.

(b) Two aircraft are approaching head-on at the same altitude.

(c) A helicopter and a fighter aircraft are at the same altitude and are converging on crossing courses.

2-24. In your own words, what constitutes acrobatic flight?

2-25. Unless required for safe maneuverability, what is the maximum KIAS airspeed for aircraft operating within a TCA?

2-26. Explain when Navy pilots should show landing lights during daylight hours on final approach.

2-27. Why is the above procedure useful to tower personnel?

2-28. State the minimum authorized altitude over a congested area.

2-29. What is the minimum authorized altitude over water or sparsely populated areas?

2-30. An aircraft flying at FL 300 would have its altimeter at what setting?

2-31. When, if ever, may a pilot deviate from the rules of FAR, Part 91?

2-32. When, if ever, may a pilot deviate from an ATC clearance?

VISUAL FLIGHT RULES (VFR)

Learning Objective: **Recognize those visual flight rules that govern the operation of aircraft.**

A pilot operating in accordance with VFRs is flying in accordance with the see-and-avoid concept. Simply defined, this means a pilot is responsible for his or her own separation from other aircraft under most circumstances. Such operations eliminate the need for specific route clearances from air traffic control agencies. Certain weather minimums are required for such flight.

Basic VFR Weather Minimums

We might point out at this time that these minimum weather conditions are exactly that—minimum. While flying in weather conditions equal to or better than those required for VFR flight, the pilot has the primary responsibility of avoiding a collision. A flight in minimum or near-minimum weather conditions is only undertaken on a VFR clearance when absolutely necessary. However, pilots do fly in what we call marginal VFR, and it is during these times when you must be extremely alert.

CLOUD CLEARANCE REQUIREMENTS.—The minimum distance from clouds that a pilot must maintain during VFR flight depends upon altitude and whether or not the flight is within controlled or uncontrolled airspace. Remember, controlled airspaces are those areas in which some or all aircraft may be

subject to air traffic control. Figure 2-10 and table 2-2 show the minimum distances from cloud formations that pilots must maintain when they fly in accordance with visual flight rules. Note that an aircraft outside controlled airspace at 1,200 feet AGL and below has only to remain clear of clouds.

VISIBILITY REQUIREMENTS.—If you refer to figure 2-10 and table 2-2, you can see that visibility minimums, like the cloud clearance standards, vary with the flight altitude and airspace. The minimum visibility requirement for flights operating within controlled airspace below 10,000 feet MSL is three miles. For flights within controlled airspace at and above 10,000 feet, the required visibility is five miles. Outside controlled airspace, the minimum visibility for VFR flights is one mile (except for helicopters). Helicopters being operated outside controlled airspace at 1,200 feet AGL or less may operate with less than one mile visibility provided they are operated at speeds that allow the pilots adequate opportunity to see any air traffic or other obstruction in time to avoid collision.

VFR WEATHER REQUIREMENTS WITHIN CONTROL ZONES.—The basic weather minimums for VFR flight within a control zone are ceiling 1,000 feet and visibility three miles. Again, these are minimums. Some airports have set higher VFR minimums because of heavy traffic conditions.

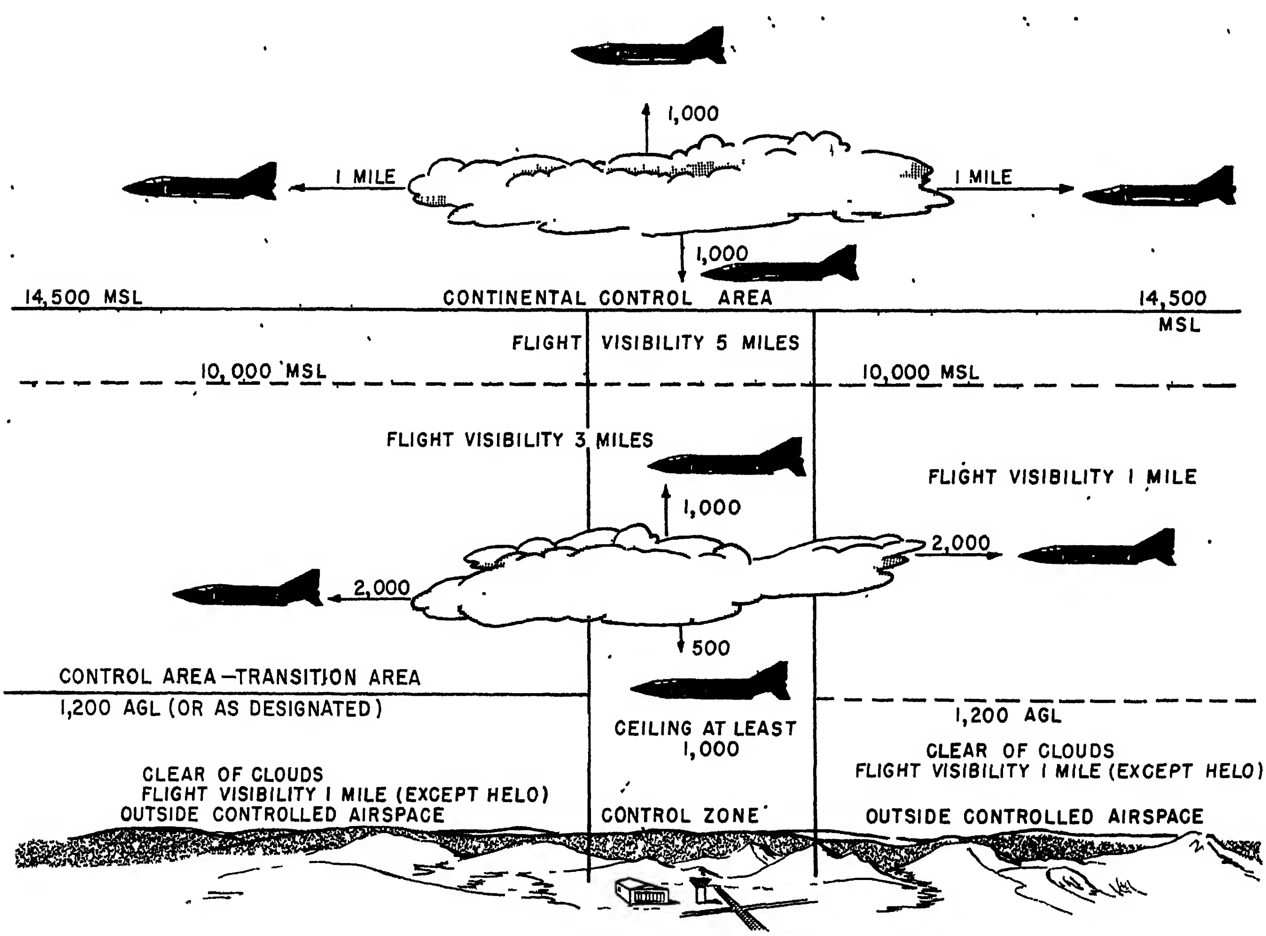

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Figure 2-10.—Basic VFR weather minimums.

Table 2-2.—Basic VFR weather minimums

Altitude	Flight visibility	Distance from clouds
1,200 feet or less above the surface (regardless of MSL altitude)—		
Within controlled airspace	3 statute miles	500 feet below. 1,000 feet above. 2,000 feet horizontal.
Outside controlled airspace	1 statute mile (except as in 91.105(B))	Clear of clouds.
More than 1,200 feet above the surface but less than 10,000 feet MSL—		
Within controlled airspace	3 statute miles	500 feet below. 1,000 feet above. 2,000 feet horizontal.
Outside controlled airspace	1 statute mile	500 feet below. 1,000 feet above. 2,000 feet horizontal.
More than 1,200 feet above the surface and at or above 10,000 feet MSL	5 statute miles	1,000 feet below. 1,000 feet above. 1 mile horizontal.

Special VFR Operations

There are exceptions to the VFR weather minimums we have discussed. When less than VFR minimums exist, landings and takeoffs or flights through a control zone may be approved, provided the following requirements are met:

1. IFR traffic will not be unduly delayed because of the operation.
2. An ATC clearance is obtained.
3. The aircraft is kept clear of clouds.
4. In the case of landing or departing aircraft, the ground visibility is at least one mile (1/2 mile minimum is authorized for air carriers), or for aircraft passing through the control zone, flight visibility is reported by the pilot to be at least one mile.

NOTE: Helicopters are exempt from the visibility minimums but not the other requirements.

Procedures and phraseology for approval/ disapproval of special VFR operations are contained in the FAA Handbook 7110.65 and Chapter 13 of this manual. No doubt your facility has additional instruction on local procedures. Finally, we want to state again: Special VFR procedures apply only to control zone operations.

VFR Cruising Altitudes

The ever-increasing speed of aircraft and number of air traffic operations pointed out that pilots now have less time to see other aircraft and react. Therefore, a positive safety factor was needed, a "built-in" safety factor so to speak—one which ensured separation from other traffic if a pilot adhered to the system. Cruising altitudes were the result. There are cruising altitudes which apply to both VFR and IFR operations, and they apply to flight in both controlled and uncontrolled airspace. (See figure 2-11.) At this point, we are dealing only with VFR cruising altitudes. The IFR system, and how the two systems function together, is discussed later.

First, let's get the exceptions out of the way. VFR aircraft are exempt from complying with

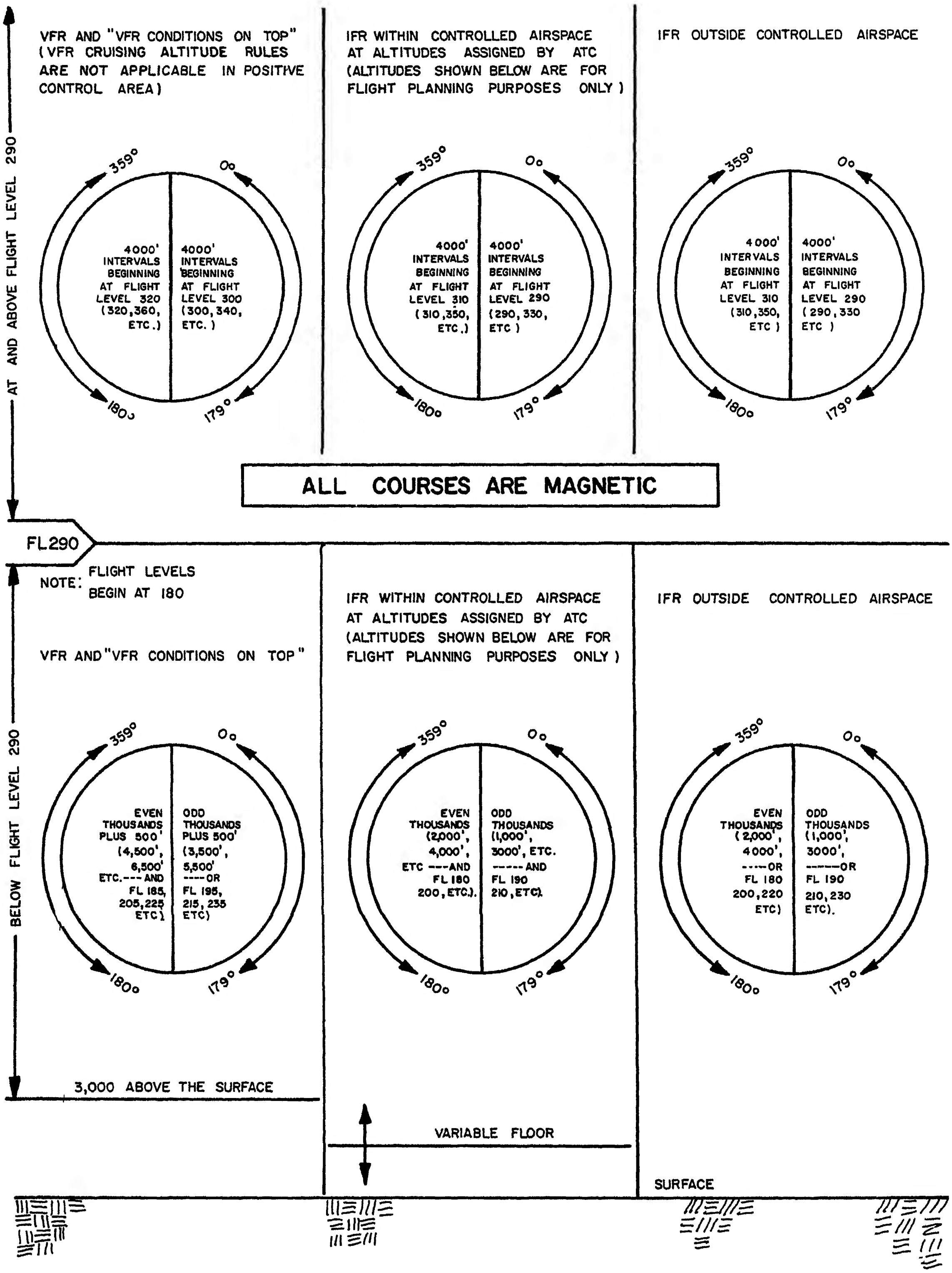

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Figure 2-11.—Cruising altitudes.

cruising altitudes when one of these conditions exist:

1. Flying at or below 3,000 feet AGL.
2. Holding in a pattern with two-minute legs or less.
3. In a turn.

In order to determine a proper cruising altitude, two things need to be considered: (1) the magnetic direction of intended flight and (2) the desired altitude of the flight. Taking these two items into account, we refer to a chart similar to figure 2-11 and select the proper cruising altitude. Notice in figure 2-11 that there are two distinct separation points in the structure of the system. The first is at 3,000 feet AGL where cruising altitudes start; the second is at flight level 290 (29,000 feet) where the vertical separation increases. Remember that we are speaking only of VFR traffic. From 3,000 feet to flight level 290, opposite direction traffic is separated vertically by 1,000 feet. Flights above flight level 290 are separated vertically by 2,000 feet. This may sound like more separation than is needed, but sandwiched in between VFR traffic is cruising IFR traffic.

Direction of flight is the important thing bearing on VFR cruising altitude selection. To illustrate, select a cruising altitude closest to 8,000 feet which would be appropriate for a magnetic course of 110°. Between 0° and 179°, the standard is odd thousands of feet plus 500 (e.g., 3,500, 5,500, FL195). Since 110° falls in this range, you should have selected 7,500 feet as the closest east-bound VFR cruising altitude to the desired altitude of 8,000 feet. The next closest cruising altitude for this direction of flight is 9,500 feet. Traffic in the other direction, west-bound or 180° through 359°, adheres to the standard of even thousands plus 500 (e.g., 4,500, 6,500, or FL185). Thus, we have 1,000 feet of vertical separation between opposite direction VFR aircraft operating below 29,000 feet.

Cruising altitudes above FL290 drop the plus 500 addition and advance to the added separation factor. Refer again to figure 2-11. Notice that between 0° and 179° any flight level beginning at FL300, at 4,000-foot intervals, is appropriate (e.g., FL300, FL340, FL380, etc.). Between 180° and 359°, any flight level at 4,000-foot intervals starting at FL320 is appropriate. This provides 2,000 feet of vertical separation between opposite direction VFR aircraft above FL290.

Weather Conditions Precluding VFR Flight

When weather conditions encountered en route preclude compliance with VFR rules, a pilot can be expected to do one of the following:

1. Alter the route of flight so as to be able to continue under VFR conditions.
2. Remain in VFR conditions until a change of flight plan can be air filed and an IFR clearance obtained.
3. Remain VFR and land at a suitable alternate airport.

EXERCISE

Use the following situation to answer exercises 2-33 and 2-34.

Aircraft N1864R departed VFR at 1150. At an altitude of 4,500′, just prior to exiting the control zone, the aircraft passes within 2,000′ horizontally to several cloud formations. The pilot continued to climb to 12,500′, reaching this altitude at 1210. At 1212, the aircraft entered uncontrolled airspace and immediately started encountering marginal VFR weather; on occasions, flight visibility decreased to four miles. At 1245, the aircraft reentered controlled airspace, and the pilot started to descend into the destination airport. While descending through 6,000′, the flight visibility decreased to three miles. Shortly afterwards, the pilot leveled off and maintained an altitude and a position 500′ above all clouds until starting final descent to the airport traffic pattern.

2-33. Were any of the VFR cloud clearance requirements violated? If so, explain when.

2-34. Were any of the VFR visibility requirements violated? If so, explain when.

2-35. What are the three flight operations that a pilot with a special VFR clearance may make?

2-36. In what/which area(s) is/are special VFR operations allowed?

2-37. What are the visibility requirements for special VFR operations?

2-38. When are aircraft operating in uncontrolled airspace subject to cruising altitudes?

2-39. A westbound VFR flight is reported cruising at 15,500 feet. Is the aircraft at a proper cruising altitude? Explain.

2-40. What action must a pilot on a VFR flight take if en route weather conditions change so as to preclude continuing the flight VFR and there is no suitable alternate airport?

INSTRUMENT FLIGHT RULES

Learning Objective: **Recognize those Instrument Flight Rules that govern the operation of aircraft.**

The effectiveness of Navy pilots depends to a large extent upon the ability to operate aircraft in all types of weather conditions. To do this with a reasonable degree of safety, you and the pilot must observe the basic regulations and control procedures that govern IFR flight. Most of FAR 91 rules apply to both military and civilian operations. However, the Navy's expressed goal to decrease the probability of midair collisions, requires Navy pilots to operate under IFRs to the maximum extent practicable without unacceptable mission derogation. To meet this goal, the Navy has added several additional requirements. No attempt is made here to separate those requirements into civil or military categories. We simply discuss the requirements that apply to the operation of Naval aircraft.

Applicability

FAR 91.115 states "No person may operate an aircraft in controlled airspace under IFR unless:

1. An IFR flight plan has been filed, and
2. An appropriate ATC clearance has been received."

Pilots must comply with IFR procedures when operating their aircraft in weather conditions that are less than VFR minimums. Additionally, Navy pilots are encouraged to use IFR procedures when their flight is conducted within the Federal airway system.

Other factors requiring adherence to IFR procedures are these:

1. When flights are conducted along jet routes (operations parallel to and within 10 miles of the established centerline are considered to be along the route)
2. Anytime aircraft are operated in established positive control areas
3. Flights to and from targets or operating areas when practicable
4. When performing instrument approaches.

NOTE: When VFR conditions exist, pilots may waive any of the above four requirements for a specific flight when necessary to circumnavigate or otherwise avoid severe weather, or when dictated by an inflight emergency.

Takeoff Minimums

Pilot's takeoff minimums are based on the lowest published landing minimums at the airport of departure. This ensures the pilot of being able to return to the departure airport and land if an

emergency should develop shortly after takeoff. Takeoff minimums for civilian airports are found in FAR 91.116. Navy pilots are instrument rated as either special or standard depending upon their qualifications and experience. If a Navy pilot holds a special instrument rating, no takeoff ceiling or visibility minimums apply. Request for takeoff depends on the judgment of the pilot and the urgency of the flight. If a Navy pilot holds a standard instrument rating, the takeoff minimums are: ceiling 300 feet and visibility one mile. If the air station has an approved precision radar approach (PAR) with published landing minimums less than 300 and one, takeoff is authorized for a standard card pilot provided the weather is at least equal to the precision approach minimums for the landing runway in use. However, in no case can a standard card pilot take off when the weather is less than 200 feet ceiling and one-half statute mile visibility or 2,400 feet runway visual range (RVR). Note: See RVR in Appendix B.

Takeoff minimums for civil contract air carriers operating from military airfields are those approved by the carrier company and the FAA. Contract flights are required to comply with military minimums if higher, when prescribed and published by the departure base.

As an AC, one of your operating procedures is to issue the official ceiling and visibility (RVR if applicable) to IFR departures when the weather is below VFR minimums or below the highest published takeoff minimums, whichever is greater. We do this to enable pilots to determine if they have the takeoff minimums prescribed for their instrument rating. You, as a controller, are only responsible for supplying the pilot with up-to-date weather information. It is the pilot's responsibility to decide if the weather meets minimums.

NOTE: FAR 91.116(d) states: Unless otherwise prescribed by the Administrator, each person operating a civil aircraft under IFR into, or out of, a military airport shall comply with the instrument approach procedures and the takeoff and landing minimums prescribed by the military authority having jurisdiction on that airport.

Minimum IFR Altitudes

Except when landing or taking off, an IFR aircraft must maintain an altitude that is no lower than the established minimum IFR altitude for its position. This is an altitude which has been determined to be the lowest that permits safe flight with regard to terrain, weather conditions, and the navigational facilities available. The minimum IFR altitude is published on charts as the Minimum Enroute Altitude (MEA) or the Minimum Obstruction Clearance Altitude (MOCA), for use on airways. There also may be a Minimum Crossing Altitude (MCA) specified. The MCA is the minimum altitude that an aircraft can cross a fix or reporting point along an airway. (See MCA, MEA, and MOCA in Appendix D, FAR, Part 95.) However, on off-airways operations such as a direct point-to-point flight, an MEA or MOCA would not be established. Where no minimum altitude has been established, Navy pilots must maintain an altitude of not less than 1,000 feet above the highest obstacle within a horizontal distance of 22 miles from the centerline of the intended course. (FAR, Part 91.119 requires a horizontal distance of five statute miles.) Over areas designated as mountainous terrain, a Navy aircraft must be flown not less than 2,000 feet above the highest obstacle within a horizontal distance of 22 miles (five miles for civil aircraft) from the centerline of the intended course.

IFR Cruising Altitudes

Remember that during our discussion of VFR rules we explained a "built-in" safety factor—cruising altitudes. Well, this cruising altitude system also applies to instrument flights. The IFR system is designed to mesh with VFR cruising altitudes to make a complete system. They play the important role of ensuring the adequate separation of aircraft in <u>uncontrolled</u> airspace. When a pilot operates in uncontrolled airspace in IFR conditions, the rule of determining a cruising altitude by direction of flight is the same as for VFR flights, except that IFR standards are used. Again, refer to figure 2-11. When a pilot plans an IFR flight, a cruising altitude is selected which best suits the planned direction of flight. We want to stress here that while in <u>controlled</u> airspace, the

pilot MUST fly at the altitude assigned by ATC. Like VFR cruising altitudes, the magnetic direction of flight influences altitude selection. So, if you examine both cruising altitude systems, VFR and IFR, it is evident that they completely ensure traffic separation (vertically) in uncontrolled airspace, regardless of which system a pilot follows. Let's take an example. In uncontrolled airspace, an east-bound VFR aircraft would be flying at odd thousands plus 500 feet, while a west-bound IFR aircraft following IFR cruising altitudes would be flying at even thousands of feet. Therefore, should they meet, a "built-in" 500-foot separation exists.

Landing Minimums

A pilot may only start an approach or a high altitude penetration for approach if the reported terminal weather indicates that existing ceiling and visibility are at or above the minimums published for the approach to be flown. However, multi-piloted aircraft may commence an approach after the weather has been reported below minimums, provided the aircraft has the capability to proceed to a suitable alternate in the event of a missed approach and there is a NATOPS qualified pilot and copilot at the controls. The absolute minima for a single-piloted aircraft is ceiling 200 feet and visibility one-half mile (2,400 feet RVR) or published minima, whichever is higher. When it is determined prior to starting an approach that the weather is below minimums, the pilot will either request clearance to a holding fix or request clearance to an alternate airport. If, however, the approach or penetration commenced prior to obtaining the necessary weather information, the pilot may continue the approach to the missed approach point. If the runway, approach lights, etc., are sighted, the pilot may proceed and land.

Approved instrument approach procedures and minimums are published in DOD Flight Information Publications (Terminal) or other similar type publications. The airport's prevailing visibility is the controlling factor for all approaches that require an aircraft to circle to another runway. It also controls straight-in approaches when Runway Visual Range (RVR) or Runway Visibility Value (RVV) information is not available. The entire field is considered below minimums when the existing visibility is lower than the lowest published visibility for an operational navigation/approach aid.

ATC IFR Clearance

As we stated earlier, a pilot must receive an IFR clearance before flying IFR in controlled airspace. This clearance is given by the ATC facility having IFR authority over the airspace in which the flight is to be conducted. The required items of an IFR clearance are:

1. Aircraft's identification
2. A clearance limit
3. The departure procedure or Standard Instrument Departure (SID) procedure
4. Route of flight
5. Altitude data (in the order to be flown)
6. Holding instructions, if necessary
7. Any special information, if any
8. Radio frequency assignment
9. Radar beacon code assignment.

Once the pilot requests and receives an IFR clearance, that pilot may not deviate from this clearance without permission. If a deviation is needed or made for emergency reasons, the pilot must notify the controlling agency as soon as possible. The agency then issues another clearance or amends the original clearance. Nothing, however, prevents a pilot from canceling the IFR clearance and proceeding under VFR.

IFR Operations; Radio Communications Failure

In the event that an aircraft loses two-way radio communications while operating under IFRs, there are specific procedures the pilot must follow. These procedures are found in FAR 91.127, and are discussed below. You must know and understand these procedures because you will be controlling other air traffic based on the actions the no-radio aircraft is expected to take.

If the failure occurs in VFR weather conditions, or if VFR conditions are encountered after the failure, the pilot must continue the flight under VFR and land as soon as practicable.

If the radio failure occurs in IFR conditions the pilot encounters IFR conditions, the pilot ust continue the flight according to the llowing:

1. Route.—By the route assigned in the last TC clearance received, or if being radar-ctored, on a direct route from the point of radio ilure to the clearance limit specified in the vector earance. In the absence of an assigned route, e pilot will proceed along the route that ATC lvised could be expected in a further clearance. the pilot has received none of the above routes, e pilot should proceed along the route requested · filed for in the flight plan.

2. Altitude.—At the highest of the following titudes or flight levels for the route segment own:

a. The altitude or flight level assigned in e last ATC clearance received;

b. The minimum enroute altitude or flight vel prescribed for segment being flown; or

c. The altitude or flight level that ATC has lvised could be expected in a further clearance. xample (see figure 2-12): The MEA between A and C is 5,000 feet. The MEA between C and D is 11,000 feet. And the MEA between D and E is 7,000 feet.

Example: A pilot has been cleared via A, B, C, D, to E. While flying between A and B the pilot was assigned an altitude of 6,000 feet and told to expect further clearance to 8,000 feet at B. Prior to receiving clearance to climb to 8,000 feet, the pilot experienced two-way radio failure. The pilot would maintain 6,000 feet until reaching B, then climb to 8,000 feet. At point C, the pilot would climb to 11,000 feet. Upon reaching D, the pilot would descend to 8,000 feet, even though the MEA was 7,000 feet, because 8,000 feet is the highest of the altitude situations stated in the above rule.

NOTE: If point C had an MCA of 11,000 feet, the pilot would start to climb to 11,000 feet prior to point C so as to cross C at 11,000 feet.

3. Leave holding fix.—If an EFC has been received, leave the clearance limit/holding fix at that time and preceed to and hold if necessary, at the holding pattern depicted for the instrument approach precedure (IAP) or at the fix from which the approach begins, as appropriate. If an EFC has not been received, the pilot is expected to

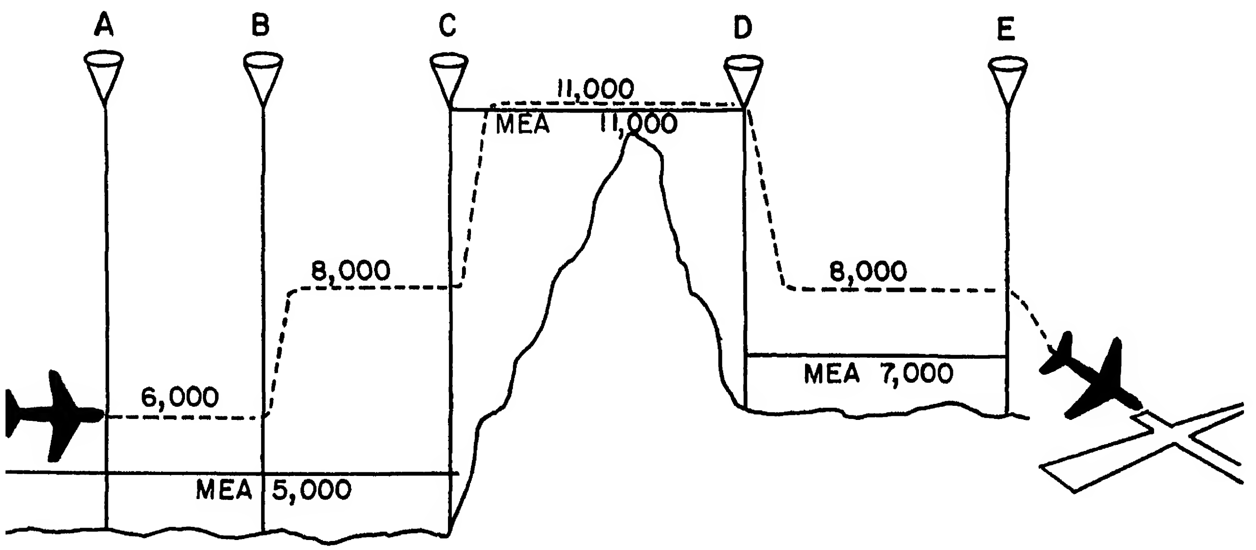

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Figure 2-12.—IFR radio communications failure.

proceed to and hold if necessary, at the holding pattern depicted for the IAP or fix from which the approach begins, as appropriate.

4. Descent for approach.—Begin descent from the en route altitude or flight level upon reaching the fix from which the approach begins, but not before the estimated time of arrival as shown on the flight plan as amended with ATC. If holding is necessary, descent to the initial approach altitude is accomplished in the holding pattern.

EXERCISE

2-41. A pilot is planning a flight which will enter PCA for a maximum of five minutes. Does the pilot need to comply with IFR?

2-42. Suppose that a Navy IFR aircraft is ready for departure but the official weather is below the published takeoff minimums for your station. Would you issue takeoff clearance? Explain your responsibilities in this case.

2-43. What are the takeoff minimums for a Navy pilot with (a) special and (b) standard instrument ratings?

2-44. Define the minimum IFR altitude.

2-45. How can you recognize the minimum IFR altitude on an en route chart?

2-46. A pilot is planning a flight from Navy Memphis to Navy Norfolk (eastbound). During preflight planning it is determined that because of forecasted winds at altitude, the best altitude for the flight is 8,000 feet. If the pilot plans to fly as near as possible to the desired altitude, what altitude should the pilot maintain if the flight is conducted (a) VFR on Federal airways, (b) IFR on Federal airways, and (c) IFR outside controlled airspace?

2-47. Assume that you are working a control position. The visibility is decreasing fast. Explain your primary responsibility here as it relates to the determination of landing minimums.

2-48. When it becomes necessary for an aircraft to circle and land on another runway, which of the following visibility values is the most important to the pilot? RVV, RVR, or prevailing visibility.

2-49. When must a pilot have an IFR clearance?

2-50. What facility provides the pilot with the IFR clearance?

SECURITY CONTROL OF AIR TRAFFIC (FAR, PART 99)

Learning Objective: **State the rules aircraft must follow when entering Air Defense Identification Zones (ADIZ).**

This subpart of FARs prescribes rules for operating aircraft in a defense area, or into, within, or out of the United States through an ADIZ.

National security in the control of air traffic is governed by FAR, Part 99. All aircraft entering domestic U.S. airspace from points outside, must provide for identification prior to entry. To facilitate early aircraft identification of all aircraft in the vicinity of the U.S. and its international

rspace boundaries, Air Defense Identification ›nes have been established. (See figure 2-13.)

PERATIONAL REQUIREMENTS

ight Plan

A flight plan must be on file in all ADIZ and istant Early Warning Identification Zones ›EWIZ) areas. The flight plan may be either IFR Defense VFR (DVFR). In some cases, the flight an must be approved by ATC prior to :parture. An airfiled VFR flight plan makes an rcraft subject to interception for positive identification. Therefore, pilots are urged to file the required DVFR flight plan either in person or by telephone prior to departure.

Two-way Radio

An operative, two-way radio must be available in all ADIZ and DEWIZ areas. If an aircraft is operating on a DVFR flight plan, and two-way radio communications cannot be maintained, the pilot may proceed in accordance with the original DVFR flight plan or land as soon as practicable. Either way, the pilot must report the radio failure to an appropriate aeronautical facility as soon as possible.

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Figure 2-13.—ADIZ and defense areas.

If an aircraft is operating within an ADIZ or DEWIZ under an IFR flight plan and two-way communications cannot be maintained, the pilot will proceed in accordance with FAR 91.127 which we discussed in the previous section.

Position Reporting

Normal IFR position reports are required in all ADIZ and DEWIZ areas. In the domestic and coastal ADIZ areas, flight under DVFR flight plans must give the estimated time of ADIZ penetration at least 15 minutes prior to penetration. In the coastal ADIZ, inbound foreign aircraft must report at least one hour prior to ADIZ penetration.

Aircraft Position Tolerances

Estimated points and times of ADIZ penetration are just that—estimates. Thus, some tolerances are allowed.

In a domestic ADIZ, tolerance is within plus or minus 5 minutes from the estimated time over a reporting point or point of penetration and within 10 nautical miles from the centerline of an intended track over an estimated reporting point or penetration point.

In a coastal ADIZ or DEWIZ, the tolerance is plus or minus 5 minutes from the estimated time over a reporting point or point of penetration and within 20 nautical miles from the centerline of the intended track over an estimated reporting point or point of penetration.

Exemptions

Aircraft operating within an ADIZ may be exempted from the National Security requirements of FAR 99 (except for special security instructions issued by the Administrator in the interest of national security), if the aircraft is operating:

1. Within the 48 contiguous states and the District of Columbia, or within Alaska, and remains within 10 miles of the departure station.
2. In coastal or domestic ADIZs north of 25 degrees North or west of 85 degrees West at a true air speed (TAS) of less than 180 knots.
3. In the Alaskan DEWIZ, if the aircraft maintains a speed of less than 180 knots and the pilot maintains a listening watch on an appropriate radio frequency.
4. Over or within 3 miles of any inland in the Hawaiian coastal ADIZ.

Exemptions may also be granted by the Air Route Traffic Control Center (ARTCC), on a local basis, for some operations within an ADIZ.

EXERCISE

2-52. What FAR governs security in control of air traffic?

2-53. When, if ever, may an aircraft with only a radio receiver operate DVFR within the Alaskan DEWIZ?

2-54. What are the position tolerances for an aircraft on a DVFR flight from Mexico City to Dallas, Texas?

2-55. Aircraft operating within an ADIZ or DEWIZ on an approved IFR flight plan must make what reports?

CHAPTER 3

METEOROLOGICAL ELEMENTS AFFECTING AVIATION

Naval aviation plays an important role in this untry's first line of defense. Consequently, val aviators must be prepared to fly anywhere any time. In order to successfully carry out this ssion, teamwork is a must. You, as an Air affic Controller, are a vital link in this team. our services are greatly needed during instrument ather conditions. In fact, if it were not for ouds and if unlimited visibility existed ntinuously, there would be very little quirement for most air traffic control services. eather not only affects your control procedures, t also affects aircraft operations as well. What you as an Air Traffic Controller need to know out weather? Despite the development of ather satellites, radar, aircraft design, radio ls, and navigation techniques, safety in flight still subject to conditions of limited visibility, rbulence, and icing.

Many decisions that you make in air traffic ntrol are based on existing weather conditions. y conditions and visibility dictate the rules and e types of separation and, in some cases, control ocedures that you use. Wind direction and locity determine your choice of runway. irbulence, icing, and thunderstorms often cause u to alter your control procedures. Naturally, u are not required to have a meteorologist's owledge of weather or to become an expert recaster. That job is left to those specifically ained in meteorology. However, you must cognize and be prepared for certain common ements of weather and be able to correctly and telligently pass along weather information both the pilot and the weather service personnel.

To enable you to recognize not only minimum ing conditions but also any differences between the actual weather conditions, as observed from the tower, and those indicated by the current report, you must have a thorough knowledge of the material contained in chapters 3 and 4. Also, you must become competent in reporting impending weather changes that, because of their unexpectedness, may not be immediately observed by the weather service personnel. At the same time, weather elements in general may be transmitted to pilots for them to make an immediate decision in the interest of safety and/or survival.

PRESSURE

Learning Objective: **Identify standard sea-level pressure and associated atmospheric terms, their characteristics, and effects.**

ATMOSPHERE

The atmosphere is divided into five basic layers with each layer having certain features. For our purpose we emphasize the troposphere (which is the closest layer to the earth) and the stratosphere, since most aircraft flights occur in these layers. Next are the mesosphere, thermosphere, and exosphere. (See figure 3-1.) These outer layers are important in theoretical meteorology. The troposphere is that layer of air beginning at the ground and ending at an average altitude of 7 miles. Thickness varies from the equator to the poles and from season to season. The troposhere is thicker over the equator than over the poles and also has a greater thickness in the summer. This

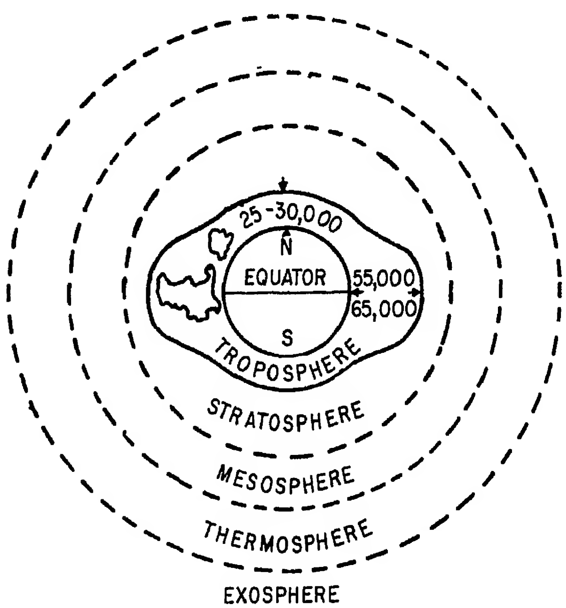

Figure 3-1.—Vertical structure of the atmosphere.

variation is due to the fact that the greater temperature in the region of the equator causes the air to be less dense and requires a greater volume, or tropospheric height, than at the poles where the cold air is very dense. The troposphere contains about three-quarters of the atmosphere by weight, and almost all of the weather. The boundary between the troposphere and the stratosphere is the tropopause. (See figure 3-2.) Its significance is that high speed winds, called "jetstream," producing clear air turbulence (CAT) are often found near the tropopause.

The stratosphere is the layer just above the tropopause. The average altitude of this layer is 7 miles at the base and 22 miles at the top. Characteristics of the layer are a slight increase in temperature with height and the near absence of water vapor. (See figure 3-2.) Occasionally, however, a strong thunderstorm will break through the tropopause into the lower stratosphere.

Atmosphere is measured by the atmospheric pressure of a column of air at any given place from the earth's surface to the top of the atmosphere. This weight is approximately 1 pounds per square inch at sea level. ' atmosphere is acted upon by the forces of grav thus, air is denser at lower levels than at hig levels due to the greater mass pushing down it. Consequently, pressure is greater at sea le and diminishes with any increase of altitude. (figure 3-3.)

PRESSURE AND TEMPERATURE CHANGES

Atmospheric pressure varies from the stand atmosphere over all areas of the earth's surfa Areas in which pressure is greater tl surrounding areas are called high-pressure ar and those having less pressure than surround areas are called low-pressure areas. ' atmospheric pressure at any given point on earth's surface is constantly changing becaus the movements of these high- and low-press areas.

Instruments have been designed to meas this pressure, such as the precision aner barometer. (See figure 3-4.) In order for tl sensitive barometers (altimeter setting indicat to read uniformly, they must be calibratec accordance with the standard atmosphere ado by the International Civil Aeronauti Organization (ICAO). The ICAO stand atmosphere assumes a mean (average) sea l temperature of 59 °F (15 °C), a standard sea l pressure of 1,013.25 millibars or 29.92 inche mercury (14.7 pounds per square inch), an avei temperature lapse rate (decrease) of 3.3 °F 1,000 feet (0.65 °C per 100 meters), an tropopause and stratosphere temperature approximately −67 °F (−55 °C). (See figure 3 Also in this figure, note that the atmosph pressure decreases at the rate of about 1 incl mercury per thousand feet of altitude up to 10. feet and that in the standard atmosphere any gi altitude corresponds to a specific atmosph pressure. The scale of the altimeter is calibra to these assumed values.

The indications read from the altimeter those that would be correct if the temperature pressure were standard for that particular altitu

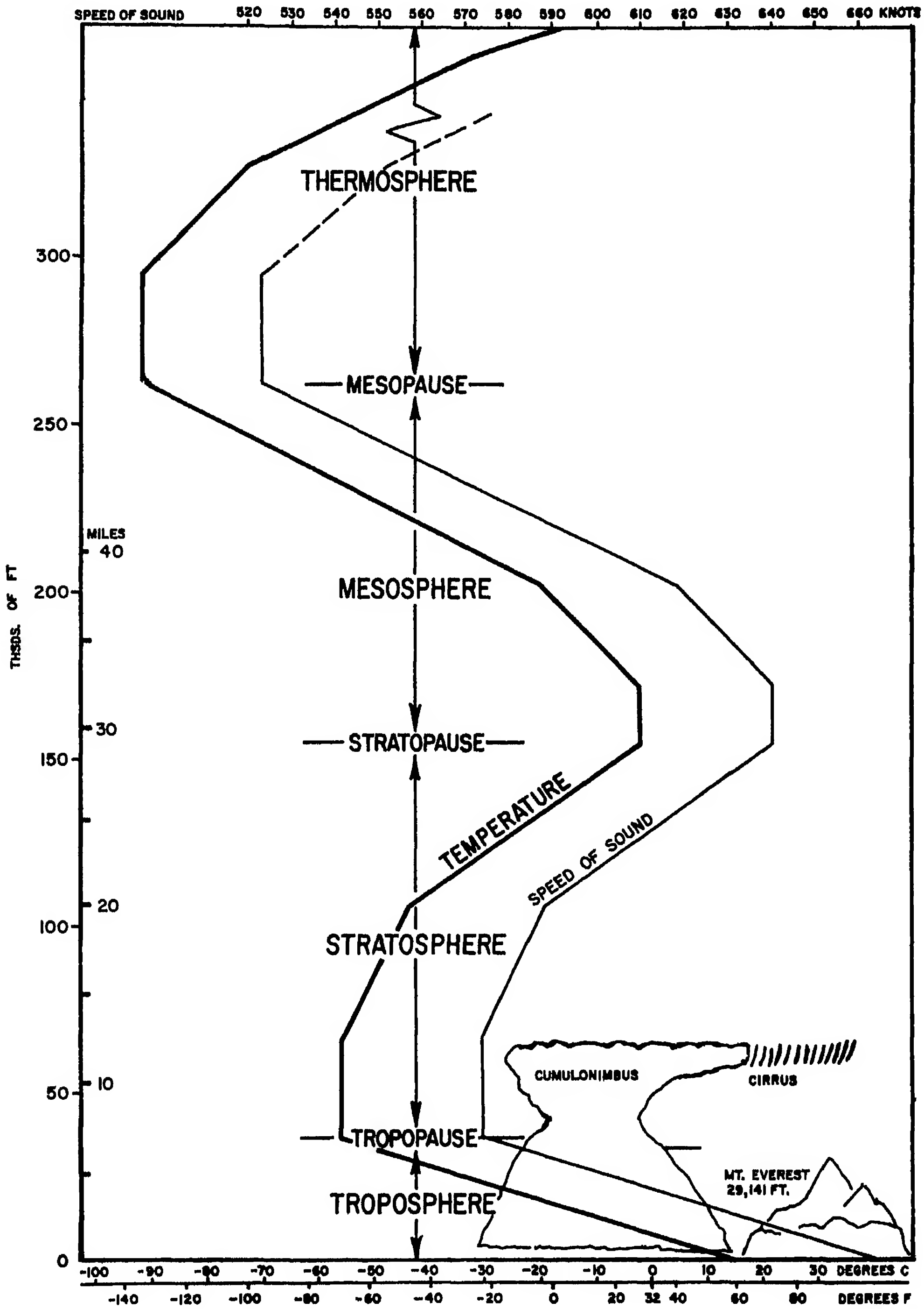

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Figure 3-2.—Vertical structure of the atmosphere.

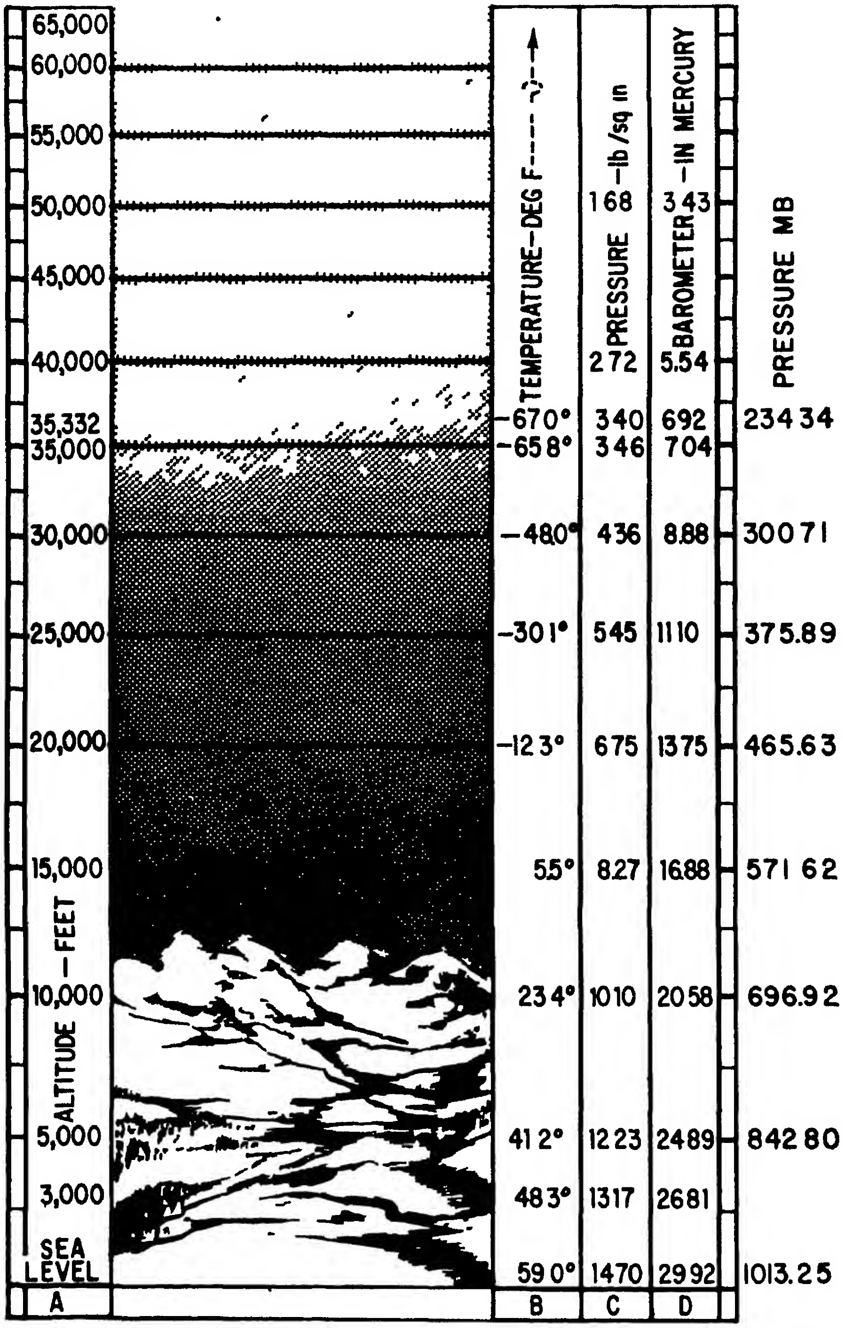

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Figure 3-3.—The standard atmosphere.

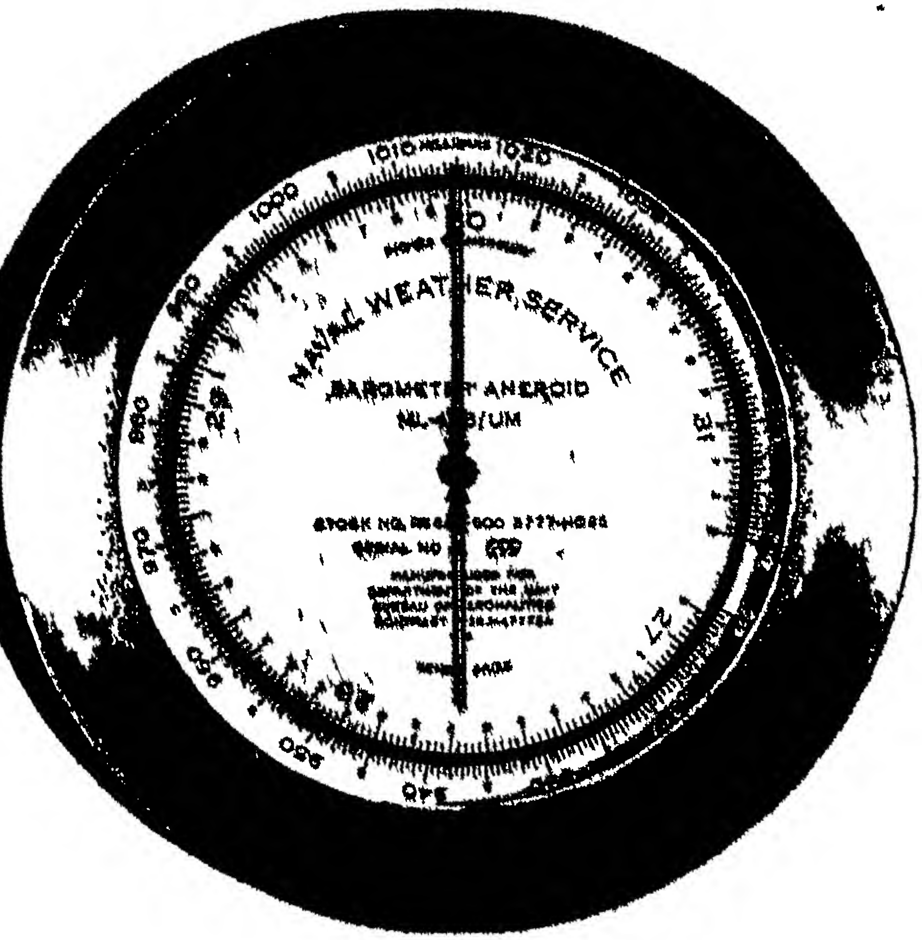

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Figure 3-4.—Precision aneroid barometer (ML-448/UM).

ɪpheric pressure and temperatures change constantly throughout the length of a thus, the aircraft's altimeter must be reset ically. If this ıs not done, incorrect readıngs ʼen by the instrument. For example, if an ʽt flies from a high-pressure area into a low-re area, the altitude reads too high. Going ı low- to a high-pressure area, the altimeter too low. (See figures 3-5 and 3-6.) Simple .o remember—HIGH TO LOW READS HIGH and LOW TO HIGH READS TOO The same rules apply to the temperature ɜs. (See figure 3-7.) Flying from a low-rature area into a high-temperature area, imeter reads too low, and from a higher temperature area to a lower temperature area, the altimeter reads too hıgh. The amount of approximate error in the altimeter readings, due to a noncurrent setting, can be determined for the lower levels of the atmosphere by applyıng the following corrections:

PRESSURE CHANGE	ALTIMETER ERROR
1 inch of mercury	1,000 feet
1/10 inch of mercury	100 feet
1/100 inch of mercury	10 feet

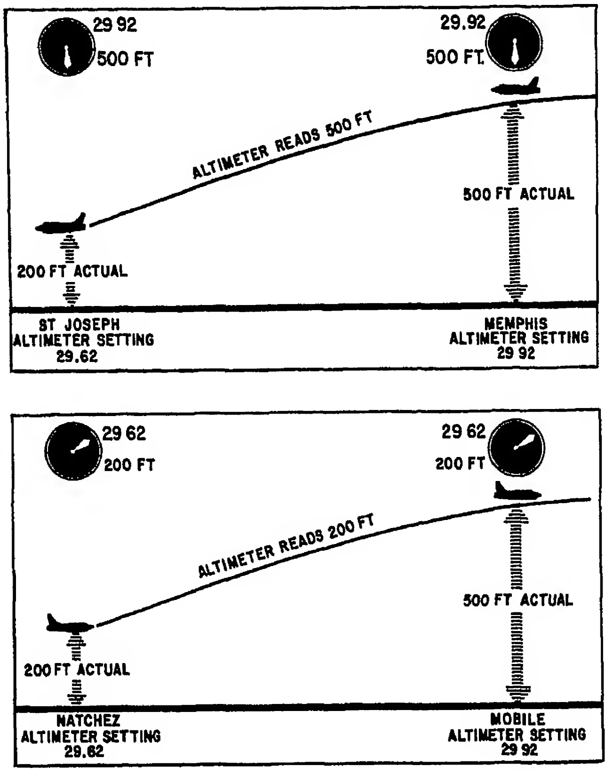

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Figure 3-5.—Effect of pressure changes.

PRESSURE SYSTEMS

Pressure systems are either cyclones (low-pressure areas) or anticyclones (high-pressure areas). The atmosphere tends to maintain an equal pressure over the entire earth just as the ocean tends to maintain a constant level. Whenever the equilibrium is disturbed, air begins to flow from areas of higher pressure to areas of lower pressure. One factor that upsets the normal equilibrium is the uneven heating of the earth. (See figure 3-8.) At the equator, the earth receives more heat than in areas to the north and south. This heat is transferred to the atmosphere, warming the air and causing it to expand and rise. Thus, an area of low-pressure (cyclone) is produced at the equator, and the heavier, cooler air from the north and south poles move along the earth's surface toward the equator to equalize the pressure. This air in turn becomes warm and rises, thereby, causing a constant circulation that might consist of two circular paths; i.e., the air rising at the equator, traveling towards the poles, and returning along the earth's surface to the equator.

This pattern of circulation, however, is greatly modified by many forces. One very important

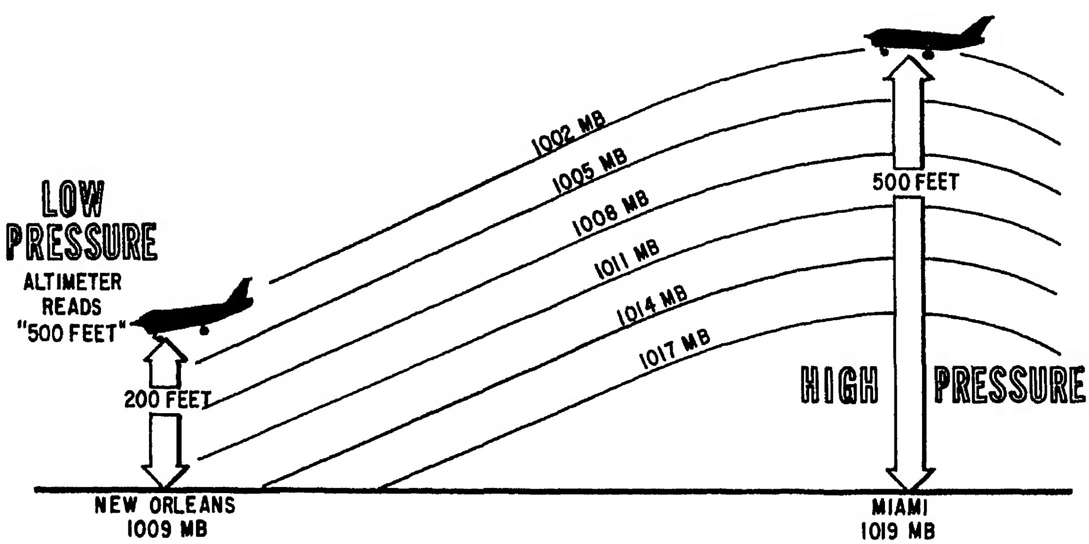

Figure 3-6.—Altimeter errors due to change in surface pressure.

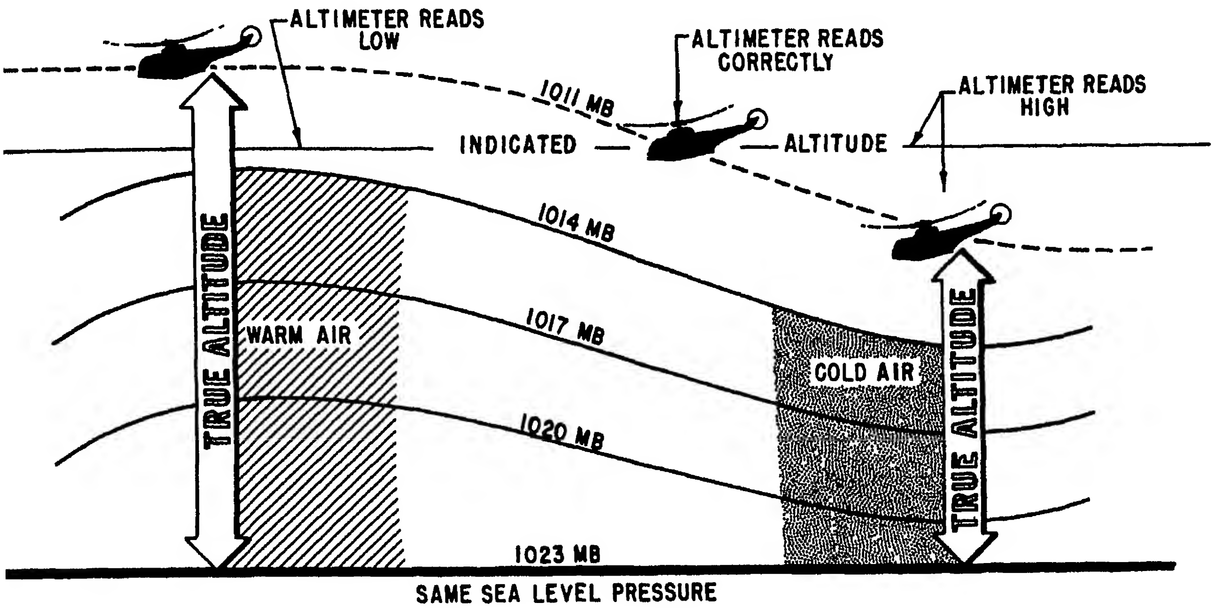

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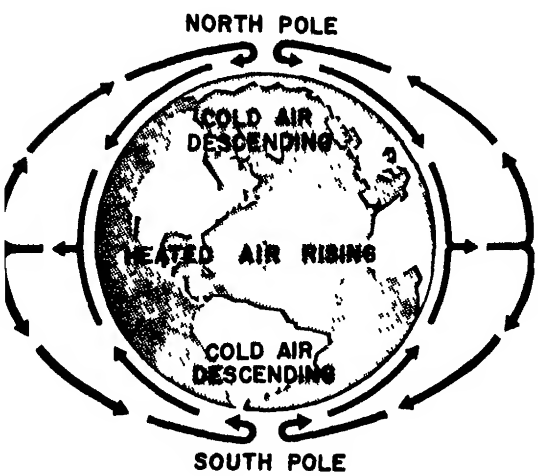
Figure 3-7.—Altimeter errors due to nonstandard air temperatures.



ıre 3-8.—Circulation as it would be on a nonrotating globe.

ce being the rotation of the earth. In the rthern Hemisphere, this rotation causes the air flow to the right of its normal path. In the ıthern Hemisphere, the air flows to the left of normal path. Additional changes in the general circulation of the air are brought about by the irregular distribution of the oceans and continents, the effectiveness of different surfaces in transferring heat to the atmosphere, the seasonal and daily temperature changes, and many other factors. In the Northern Hemisphere, a general cycle of highs and lows, and thus weather, moves from west to east. (See figure 3-9.)

Cyclones

A cyclone is a low-pressure system in which the barometric pressure decreases toward the center. The windflow around a cyclonic system is counterclockwise and inward in the Northern Hemisphere. (See figure 3-10.) The terms low and cyclone are interchangeable. Any pressure system in the Northern Hemisphere with a counter-clockwise (cyclonic) windflow is a cyclone.

Low-pressure systems with severe storm characteristics are called hurricanes, typhoons, or tropical storms which are terms used to identify the exact nature of the storm.

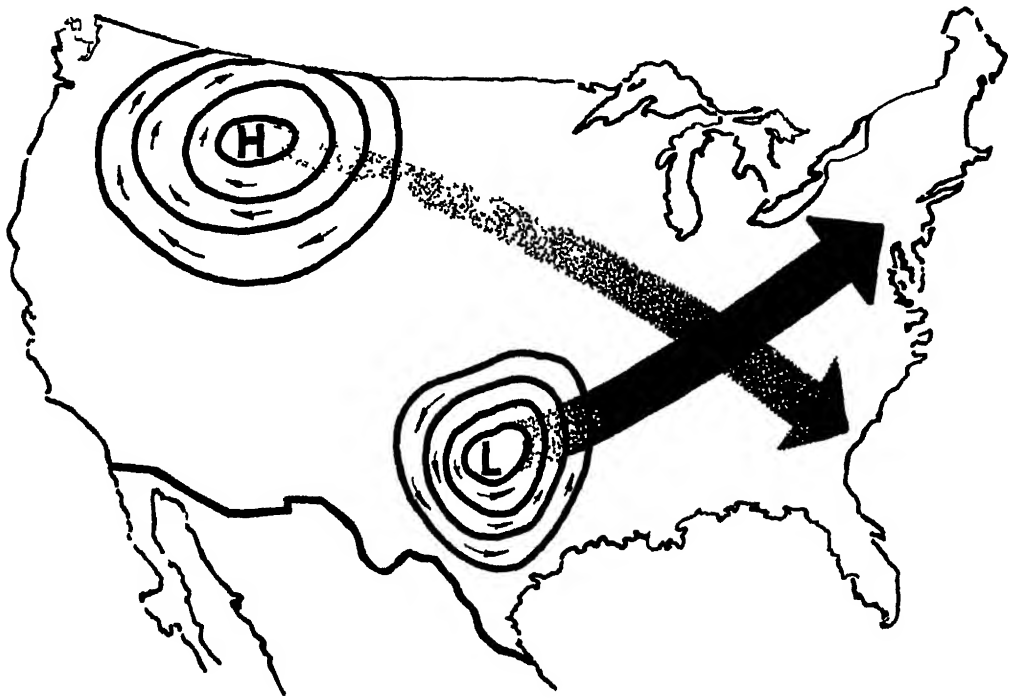


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Figure 3-9.—Directional movement of the pressure systems.

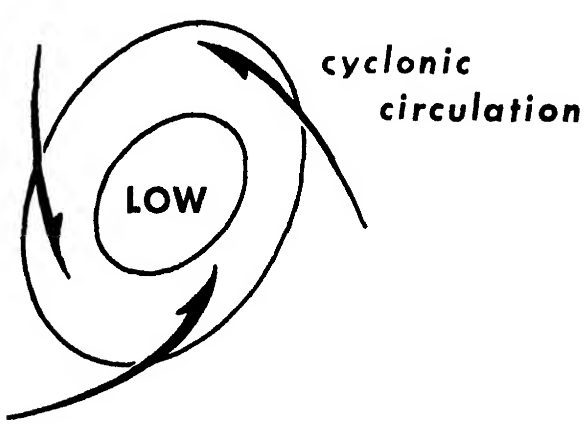

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Figure 3-10.—Cyclone.

Unfavorable flying conditions in the form of low clouds, restricted visibility by precipitation and fog, strong and gusty winds, and turbulence are common in low-pressure systems.

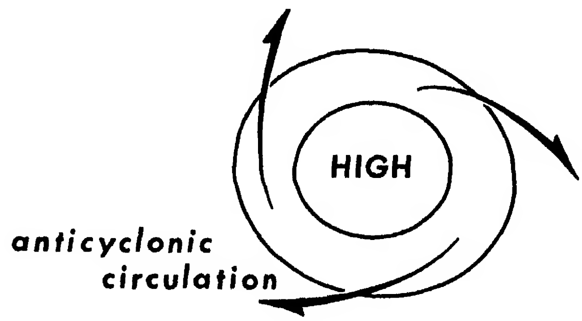

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Figure 3-11.—Anticyclone.

Anticyclones

An anticyclone is a high-pressure system in which the barometric pressure increases toward the center, and the windflow around the system is clockwise and outward in the Northern Hemisphere. (See figure 3-11.) Any pressure system in the Northern Hemisphere with a

ockwise (anticyclonic) windflow is an ıticyclone.

Flying conditions are generally more favorable high-pressure systems than in low-pressure stems because of less clouds, better daytime sibility, light or calm winds, and less ıncentrated turbulent areas.

urricanes and Tornadoes

The two most violent atmospheric sturbances found in the United States are the ırricane and the tornado. Both are cyclonic stems. The hurricane is a tropical cyclone. ·opical cyclones have been given names in fferent regions of the world, such as, hurricanes" in the Atlantic and eastern North acific areas; "typhoons" in the western Pacific eas; and "willy-willies" in Australia.

HURRICANES.—A hurricane is a low-pressure area with a whirling eddy of air having a diameter of 60 to 1,000 miles. (See figure 3-12.) It is accompanied by wind speeds as high as 175 knots or more. Along with the winds there is an *abundance of precipitation and thunderstorm* activity which may spawn tornadoes.

A peculiarity of the hurricane is the calm center of the storm called the eye. The eye is caused by the strong cyclonic wind flow (counterclockwise and spiraling inward) around the center of an extreme low-pressure system. When the eye of the storm passes over a given locality, the wind, which has been extremely violent and knocking at your front door, suddenly decreases to a much lower intensity and at times becomes calm. The precipitation stops and the sun or stars become visible. After the eye passes, the violent winds, precipitation, and thunderstorm activity begin anew. However, the winds will be blowing from

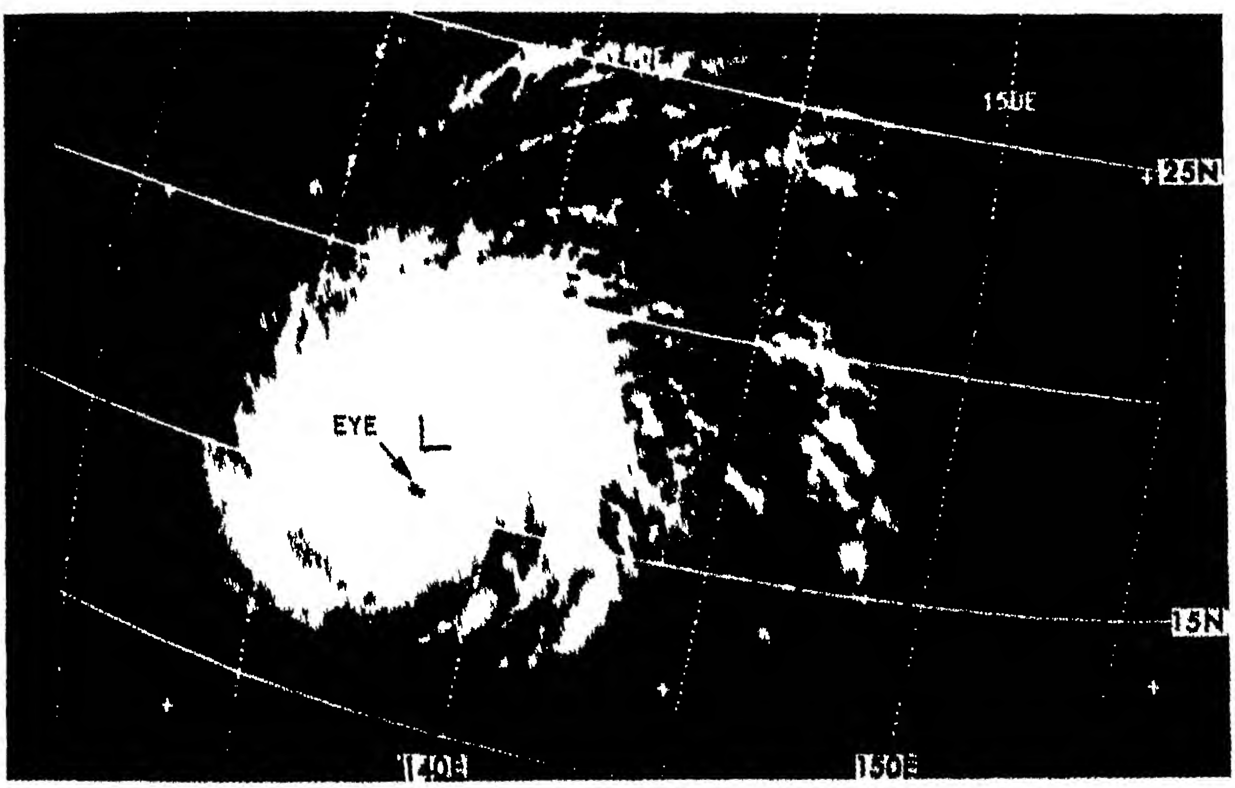

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Figure 3-12.—Satellite picture of typhoon Gilda in the Pacific Ocean showing a distinct "eye".

the opposite direction. That is to say, they will now be knocking at your back door.

TORNADOS.—A tornado consists of a funnel cloud with a violently whirling center. (See figure 3-13.) It is usually a quarter of a mile or less in diameter. The length of a tornado's track on the ground may be from a few hundred feet to 300 miles, the average being around 25 miles. Winds in the vortex of a tornado may exceed 500 knots. The forward speed of the tornado over the earth's surface is comparatively slow, usually 25 to 50 knots.

Because of a tornado's highly localized nature and its erratic tendencies, it is difficult for the meteorologists to forecast the exact location at which one will strike. However, forecasting centers do broadcast tornado watches when conditions are favorable for tornado development in specified areas, and tornado warnings when one has been sighted.

209.63
Figure 3-13.—Stages of development of a tornado.

AIR MASSES

An air mass is defined as any huge body of air whose physical properties (temperature and humidity) are homogeneous (horizontally and vertically uniform). The prevailing weather over an area at any given time generally depends on these properties and the character of the prevailing air mass.

CLASSIFICATION

Air masses are classified geographically (where they originate or form) and thermodynamically (relative warmth or coldness of its air).

The surface or region over which an air mass originates is called the "source region." It is in this region that the basic classification and characteristics of the air mass are acquired. In order to fulfill the requirements for a good source region, an area must be of uniform surface (either all land or all water), uniform temperature, and preferably, an area of high pressure where air has a tendency to stagnate. The geographical classification, which refers to the source region, divides air masses into four basic categories. These are: arctic/antarctic (A), polar (P), tropical (T), and equatorial (E). The first three are further divided into maritime (m) and continental (c). An air mass is considered to be maritime if its source of origin is over an ocean or large body of water. This type of air mass contains considerable moisture and will normally produce some type of precipitation along its path. If the air mass originates over a land surface, it is considered continental (dry or low moisture content). Virtually all equatorial air masses are considered to be maritime in origin and are designated neither c nor m but simply E. (See figure 3-14).

The thermodynamic classification applies to the relative temperature of the air mass in relation

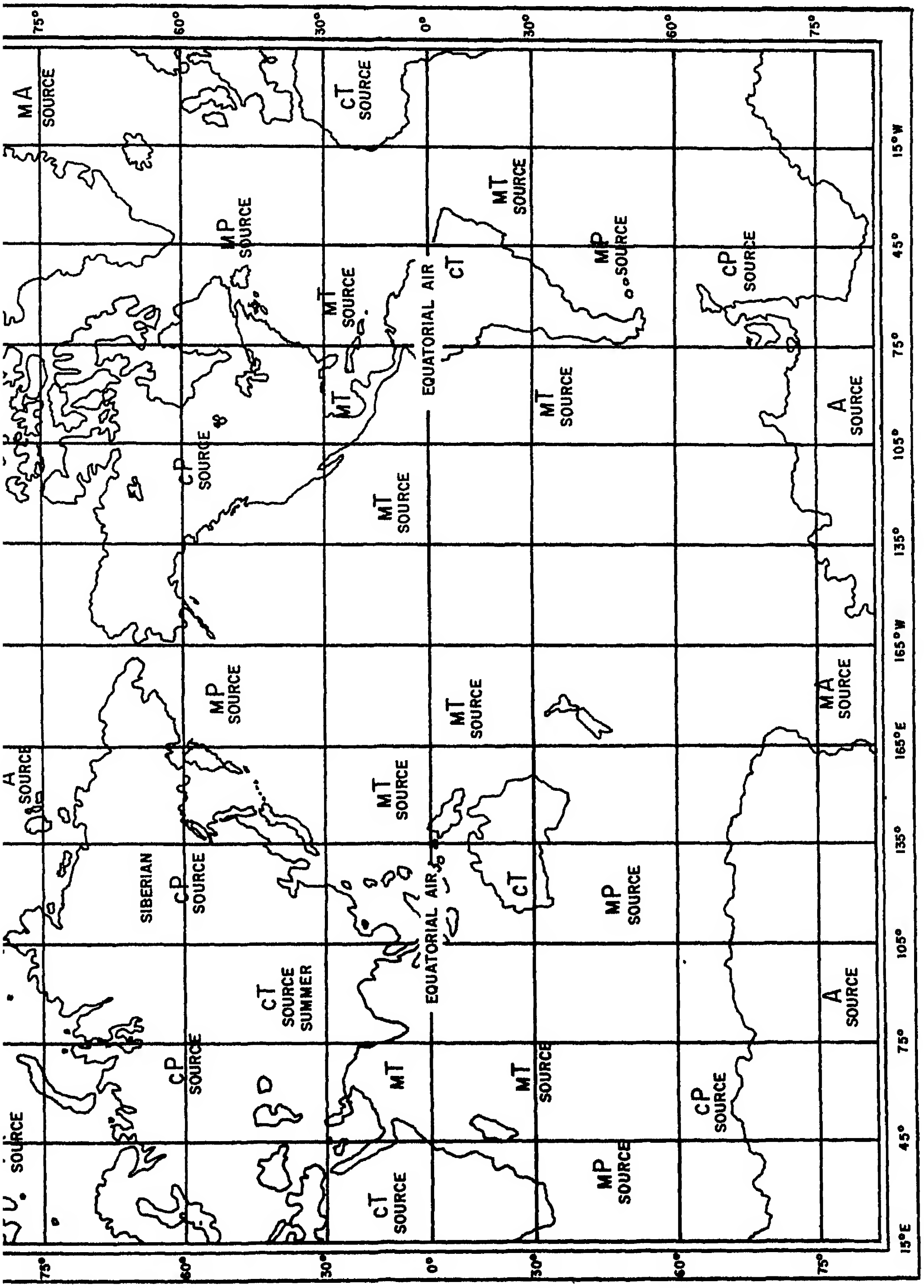

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Figure 3-14.—Air mass source regions.

to the temperature of the underlying surface. A warm air mass (w) is one which is warmer than the underlying surface; a cold air mass (k) is one which is colder than the underlying surface. For example, a continental polar cold air mass is classified as a cPk. An mTw classification indicates that the air mass is a maritime tropical warm air mass. Sometimes, the thermodynamic classification may change from night to day. A particular air mass may show k characteristics during the day and w characteristics at night and vice-versa.

PROPERTIES MODIFICATION

The basic characteristics of any air mass are temperature and humidity. These properties are relatively uniform throughout the extent of the air masses. The source region of an air mass has a primary influence upon the characteristics of the air mass. The path over which an air mass travels, after leaving the source region, and the length of time the air mass has been away from the source region (its age) also determine its characteristics.

As an air mass slowly moves out of its source region to influence other regions, it travels along a certain path. The surface, over which this path takes the air after leaving the source, modifies the air mass. For example, a warm, moist body of air moves out over cold, dry land and its characteristics are modified; therefore, moisture is lost and temperature is lowered.

Another factor which must not be overlooked in determining how an air mass is being changed or modified is the "age" of that body of air after leaving the source. For example, an air mass which has recently moved from the source region will not have had time to become modified significantly. However, an air mass which has moved to a new region and stagnated for some time will have lost many of its original characteristics. It will have acquired many of the characteristics of the surface over which it now lies.

EXERCISE

3-1. In what layer of the atmosphere does most weather occur?

3-2. Why is the atmospheric pressure likely to be higher at sea level than at 5,000 feet?

3-3. What is the standard atmospheric pressure at sea level?

3-4. Which type of pressure system produces the most severe weather in the Northern Hemisphere?

3-5. Complete this exercise by filling in, under column B, the probable source regions and categories of the air masses listed under column A.

A.	B.
a. Warm dry	________________
b. Warm moist	________________
c. Cold dry	________________
d. Cold moist	________________

CLOUDS

Learning Objective: **Recognize the major cloud genera, characteristics, and levels at which they occur.**

A cloud is a visible mass of minute water droplets, or ice particles, suspended in the

nosphere. It differs from fog in that it does not ach to the surface of the earth. Whether the ass is called a cloud or fog depends on how high how low it is. Varying weather conditions are imately associated with different types of ouds and cloud formations. For this reason, it highly important for you to be familiar with d thoroughly understand the different cloud assifications.

An international classification of clouds was ablished to provide a common nomenclature roughout the world for specific cumuliform and atiform clouds. The names adopted are based on the appearance of the clouds.

LOUD FORMATIONS

Clouds are formed through the condensation of oisture vapor (which may or may not be frozen) the atmosphere. The formal identification of oud types depends upon their shape, structure, ansparency, and color. Generally, clouds are und at varying height ranges within the mosphere from sea level to 60,000 feet. This rtion of the atmosphere has been divided into ree levels, called etages (high, middle, and low) r cloud classification (genera) purposes. Clouds esent in the high etage (level) are referred to as gh or cirroform clouds; those in the middle etage middle or altoform and nimboform; and those the low etage as low or stratoform. The ten ost common genera of clouds in their applicable age are listed below:

gh Etage	Middle Etage	Low Etage
Cirrus	(1) Altocumulus	(1) Stratocumulus
Cirrocumulus	(2) Altostratus	(2) Stratus
Cirrostratus	(3) Nimbostratus	(3) Cumulus
		(4) Cumulonimbus

The height ranges of these levels vary cording to the world climatic region in which ey are located. The height ranges of these levels (etages) and world climatic regions are shown as follows:

Etage	Polar Region	Temperate Region	Tropical Region
High	10,000-25,000 ft	16,500-45,000 ft	20,000-60,000 ft
Middle	6,500-13,000 ft	6,500-23,000 ft	6,500-25,000 ft
Low	Near Surface - 6,500 ft	Near Surface - 6,500 ft	Near Surface- 6,500 ft

In addition to the preceding classifications, cumulus and cumulonimbus clouds usually have bases in the lower etage, but their tops often reach into the middle and high etages.

Figure 3-15 is a view of the cloud classifications shown at their average heights.

CLOUD GENERA

Although clouds are continuously in the process of development and dissipation, they nevertheless have many distinctive features. Having outlined the classifications and average levels of where they occur, it is now necessary to study cloud recognition features and the weather associated with each, as well as how they affect aviation.

Cirrus Clouds (Ci)

These clouds are fibrous and delicate in appearance, looking like white wisps against the blue of the sky. They appear in a number of forms, occasionally as curls or feathery plumes. (See figure 3-16.)

Flying conditions within cirrus clouds are good. Turbulence is negligible, and the pure ice crystal composition of the cirrus cloud precludes surface icing. Cirrus clouds may indicate the first signs of approaching bad weather. Cirrus wisps, which become more and more compact and then merge into cirrostratus, may indicate an approaching warm front (fronts are discussed later in this chapter).

Cirrocumulus (Cc)

These clouds appear like fleecy flakes or very small white cotton balls. The term "mackerel sky"

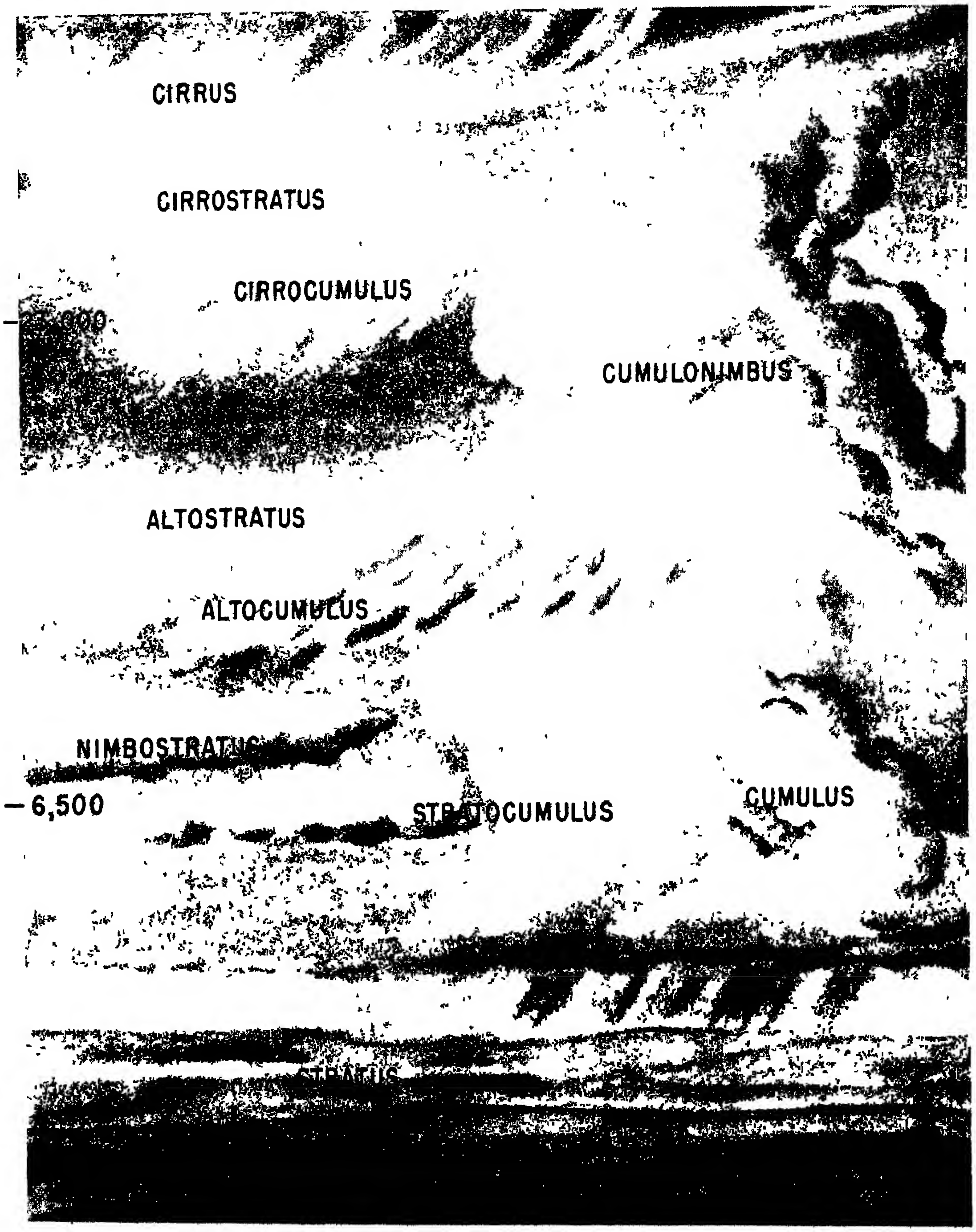

Figure 3-15.—International classification of clouds. 201.42

is given to this family because the cloud pattern often appears much the same as the scales on a fish. (See figure 3-17.) Cirrocumulus clouds are relatively rare and appear only in the presence of cirrus or cirrostratus clouds.

Cirrocumulus is a cumuliform cloud but offers only light turbulence. Due to its ice crystal composition no icing occurs on aircraft surfaces. Vapor trails can be noticed within these clouds due to the high moisture content.

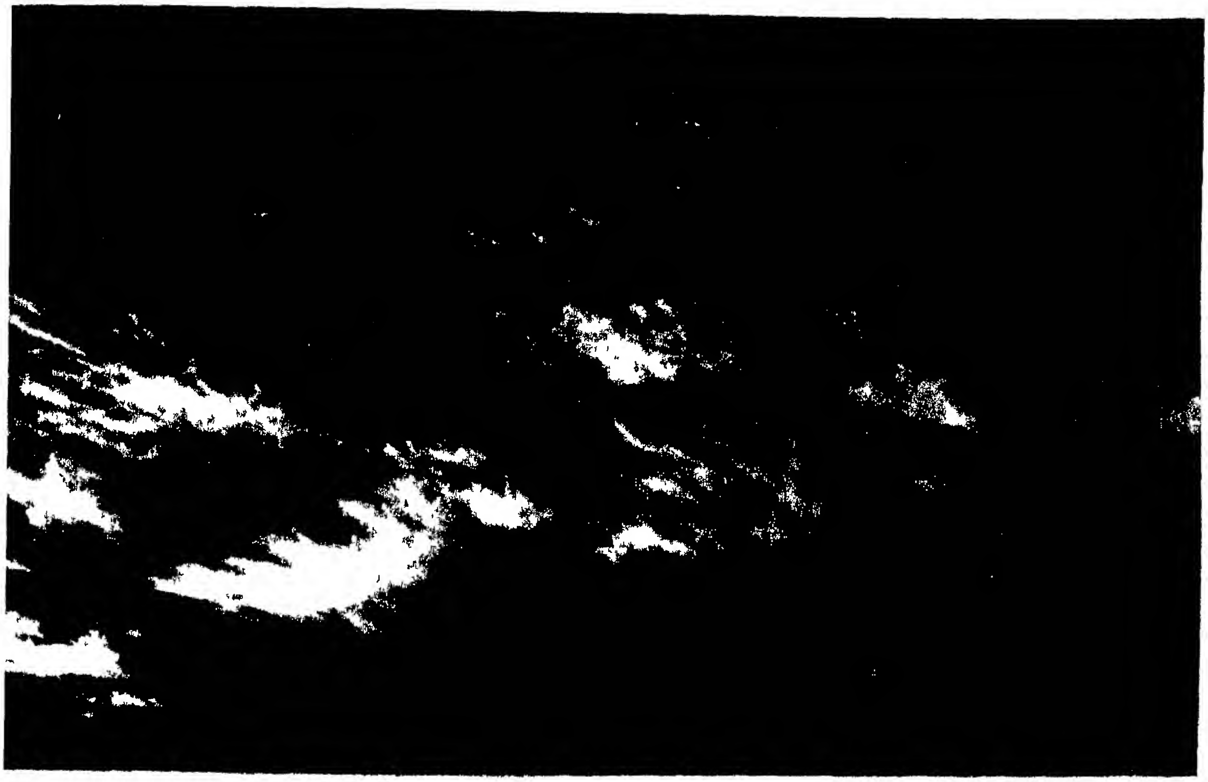

Figure 3-16.—Cirrus clouds. 201.43

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Figure 3-17.—Cirrocumulus clouds.

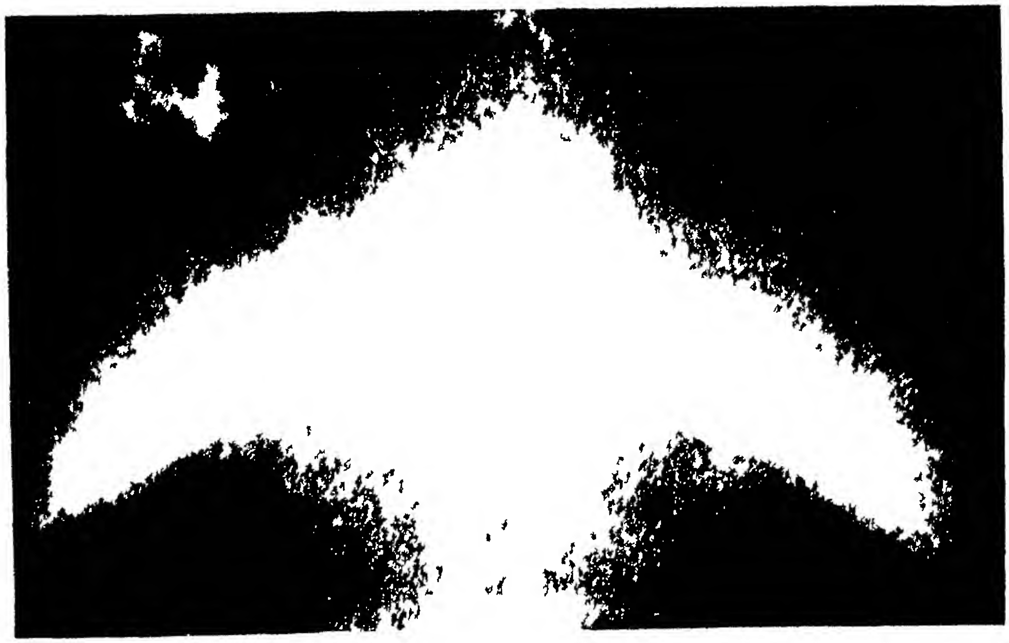

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Figure 3-18.—Cirrostratus clouds.

201.46

Figure 3-19.—Altocumulus clouds.

ıstratus (Cs)

irrostratus appears as a white veil covering most of the sky. It is a smooth, thın layer l and gives the sky a very milky appearance. easily recognized by the halo it produces nd the sun or moon. (See figure 3-18.)

˙ cirrus clouds precede the cirrostratus and irrostratus lowers, thickens, and merges into :ratus, the approach of a warm front and bad her is imminent.

:ing conditions and turbulence in cirrostratus ls usually offer no hazard to flying.

cumulus (Ac)

ıltocumulus sometimes looks like cumulus, but the individual cloud balls or :s are always larger, thicker, and grayer. The :r of the underside of each cloud is dark due to the cloud's thickness. These ball-like masses often appear similar to a herd of sheep in the sky. Sometimes altocumulus is arranged in paralled bands stretching across the sky. (See figure 3-19.)

The visibility within this cloud is poor, and the cloud usually lacks continuity. Turbulence and ıcing are light to moderate. The icing, if present, is usually the clear type (types of air frame icing are discussed later ın thıs chapter).

Altostratus (As)

Altostratus appears as a thick gray or blue-gray smooth overcast. It is thicker and less transparent than cirrostratus, which often lowers and gradually merges with the altostratus of an approaching warm front. The sun or moon shines through altostratus weakly as through ground glass. (See figure 3-20.)

201.47

Figure 3-20.—Altostratus clouds.

This cloud is composed of waterdrops, but ice crystals may also be present in upper levels. The icing conditions are light to moderate and predominantly form rime ice. Turbulence is light. The thickness is usually between 1,000 to 5,000 feet, but in some cases may be somewhat thicker. Visibility within the cloud averages between 50 to 200 yards. Precipitation falls from altostratus in the form of light rain or snow.

Nimbostratus (Ns)

Nimbostratus is a thick, dark, gray cloud. (See figure 3-21.) It is ominous and formless in appearance. Rain, snow, or other precipitation is actually falling from this cloud, whether it reaches the surface or not. The sun or moon disc is not visible through nimbostratus. There are also ragged scud clouds below the base of the nimbostratus. Turbulence and icing may be moderate to heavy with very poor visibility within and below nimbostratus.

201.48

Figure 3-21.—Nimbostratus clouds.

Nimbostratus clouds are classified as a middle etage cloud; however, they normally extend downward into the low cloud etage. Low ragged clouds frequently occur below the nimbostratus layer, with which they may or may not merge.

Stratocumulus (Sc)

Stratocumulus usually occurs as an extensive and fairly level layer marked by thick rolls and dark rounded masses of clouds. Its cloud masses are larger, thicker, and darker than those of altocumulus. They may have either small or large breaks between the rolls; however, they may form a continuous layer without any breaks. (See figure 3-22.)

The visibility within this type cloud is poor. Turbulence in stratocumulus clouds is light to moderate, and the icing conditions are moderate and may form clear ice. The precipitation from stratocumulus clouds is generally showers of rain or snow.

Stratus (St)

Stratus is a flat, shapeless, rather uniform layer of clouds which appear dull gray. (See figure 3-23.) Stratus yields precipitation in the form of drizzle only. Visibility within stratus is very poor. Only light turbulence and light

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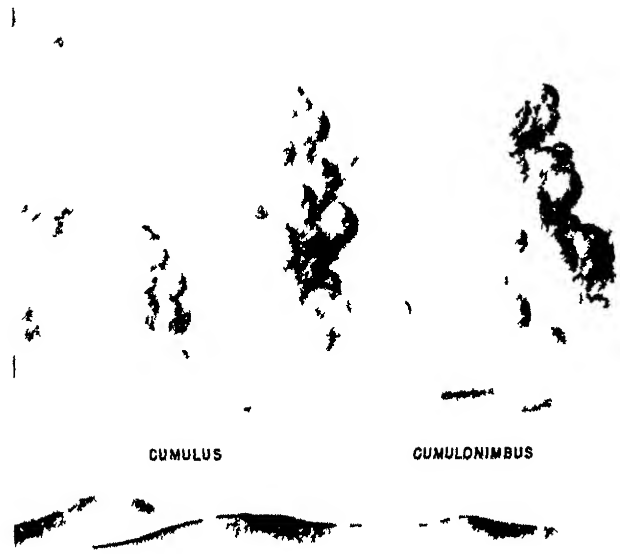
Figure 3-22.—Stratocumulus clouds.

210.50
Figure 3-23.—Stratus clouds.



201.51
Figure 3-24.—Cumulus and cumulonimbus clouds.

to moderate icing may be present. Visibility below the base of stratus is very poor if drizzle is occurring.

Cumulus (Cu)

Cumulus clouds are dense clouds with vertical development. Their upper surfaces are shaped and exhibit rounded protuberances, while their bases are nearly horizontal. Strong updrafts exist under and within all cumulus formations. In fact, cumulus clouds are caused by updrafts. Turbulence and icing conditions of varying intensities are common within cumulus clouds, depending upon the extent of vertical development. (See figure 3-24.)

Cumulonimbus (Cb)

Cumulonimbus are cumulus clouds with great vertical development whose cumuliform summits resemble mountains or towers. Cumulonimbus are the familiar thunderclouds. Their tops, which may extend higher than 60,000 feet, are composed of ice crystals and often resemble an anvil. (See figure 3-24.) Precipitation associated with Cb is of a violent, intermittent, showery character. Hail often falls from well developed Cb.

Other Clouds

TOWERING CUMULUS (TCU).—Large cumulus clouds which extend to the higher levels. They usually precede cumulonimbus clouds and indicate very turbulent conditions.

CUMULONIMBUS MAMMATUS (CBMAM).—Large baggish clouds which have protuberances, like udders or pouches on the undersurface and have excessive vertical motion. Such clouds indicate extreme turbulence and are associated with the formation of tornadoes. (See figure 3-25.)

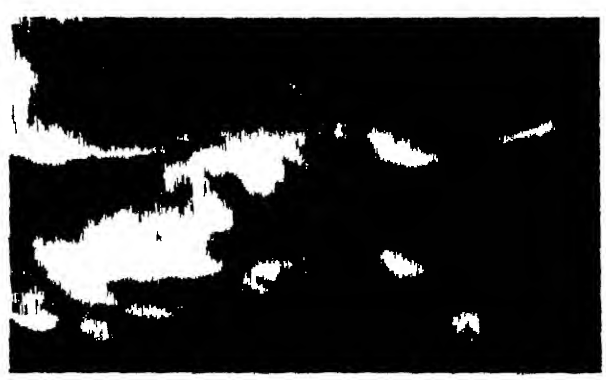


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Figure 3-25.—Cumulonimbus Mammatus clouds.

CASTELLANUS.—Clouds which present, in at least some portion of their upper part, cumuliform protuberances in the form of a castle or turret. The castellanus character is especially evident when clouds are seen from the side. Altocumulus Castellanus (ACCAS) clouds normally indicate an approaching thunderstorm and are associated with at least moderate turbulence.

LENTICULAR.—Clouds having the shape of lenses or almonds, normally formed by wind flow in mountainous areas. These clouds are sometimes associated with extreme turbulence.

EXERCISE

3-6. Match each of the following figure numbers with its cloud genera (classification).

a. Figure 3-17

b. Figure 3-19

c. Figure 3-21

d. Figure 3-24

3-7. Of all clouds, which one is associated with the most extreme weather and turbulence conditions?

FRONTS AND ASSOCIATED WEATHER

Learning Objective: **Identify types, effects, designations, and characteristics of fronts.**

A front is defined as a boundary, or line of discontinuity, separating two different air masses. From the definition, you can see the close relationship that exists between air masses and fronts. In fact, without the air masses there would be no fronts. A front is a surface, like a thin elastic sheet, separating two air masses.

In our discussion of air masses, you learned that when air stagnates over certain regions it acquires properties from the underlying surface and forms an air mass. In time, these air masses move out of their source region. As you saw in figure 3-14, due to the general circulation of the earth and atmosphere, terrain, and other factors, in the Northern Hemisphere the cold air from polar regions tends to move southward while the warm air from tropical regions tends to move northward. Therefore, it is inevitable that somewhere in the middle, air masses meet. Upon meeting they do not mix readily, each air mass tending to remain intact. The surface which separates the air masses is called a frontal surface. This frontal surface is drawn on surface weather maps as a line at the point of intersection with the earth's surface. The line itself is called the surface front. (See figure 3-26.)

As previously stated, the boundary between two different air masses is called a front. This may be a relatively sharp separation that marks a change from one air mass to the other, or it may be a zone across which the properties of one air mass slowly change to those of the other. (See figure 3-27.) A sharp front may be only 2 or 3 miles wide at the ground, whereas a diffuse (wider) front may be 50 to 70 miles wide. If the transition zone from one air mass to the other is larger than this, the boundary is called a frontal zone.

Fronts are generally classified according to the relative motions of the air masses involved. The four chief classifications are as follows:

(1) Cold front—a front whose motion is such that cold air displaces warm air at the surface.

(2) Warm front—a front whose motion is such that warm air replaces cold air at the surface.

(3) Stationary front—a front which has little or no motion.

(4) Occluded front—a complex front resulting when a surface cold front overtakes a warm front.

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Figure 3-26.—The meeting of two different air masses.

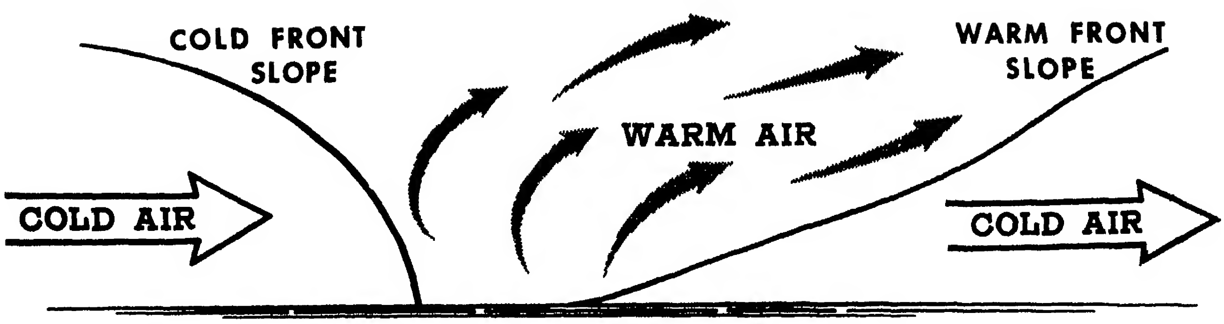

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Figure 3-27.—Vertical cross section of frontal systems (without clouds shown).

The weather associated with fronts and frontal movements is called frontal weather. It is more complex and variable than air mass weather. The type and intensity of frontal weather is determined largely by such factors as the slope of the front, the water vapor content and stability of the air masses, the speed of the frontal movement, and the relative motion of the air masses at the front. Because of the variability of these factors, the frontal weather may range from a minor wind shift with no clouds or other visible weather activity to severe thunderstorms accompanied by low clouds, poor visibility, hail, and severe turbulence and icing. In addition, the weather associated with one section of a front is frequently quite different from that in other sections of the same front. Let's consider, however, each of the frontal categories along with a typical weather pattern it usually produces.

COLD FRONTS

When cold air invades a region occupied by warm air, it wedges under the warm air pushing it upward. The frontal surface in this case is called a cold frontal surface, and its intersection with the earth's surface is called a cold front. (See figure 3-28.)

There are certain weather characteristics and conditions that are associated with the passage of cold fronts. In general, the temperature and humidity decrease, the pressure rises, and in the Northern Hemisphere the wind shifts clockwise (usually from southwest to northwest) with the passage of a cold front. The distribution and type of cloudiness and the intensity and distribution of precipitation depend primarily on the vertical velocities, stability, and moisture in the warm air mass. Another important factor is also the speed at which the cold front moves, and on this basis they are classified as fast- or slow-moving.

With the slow-moving cold front there is a general upglide of warm air along the entire frontal surface except for pronounced lifting along the lower portion of the front. The average slope of the front is approximately 1:100 (1 mile vertical to 100 miles horizontal). The cloud and precipitation area is extensive and is characterized by cumulonimbus and nimbostratus clouds, showers, and thunderstorms at and immediately to the rear of, the surface front. This area is followed by a region of rain and nimbostratus clouds merging into a region of altostratus clouds and then cirrostratus clouds, which may extend several miles behind the front. The development

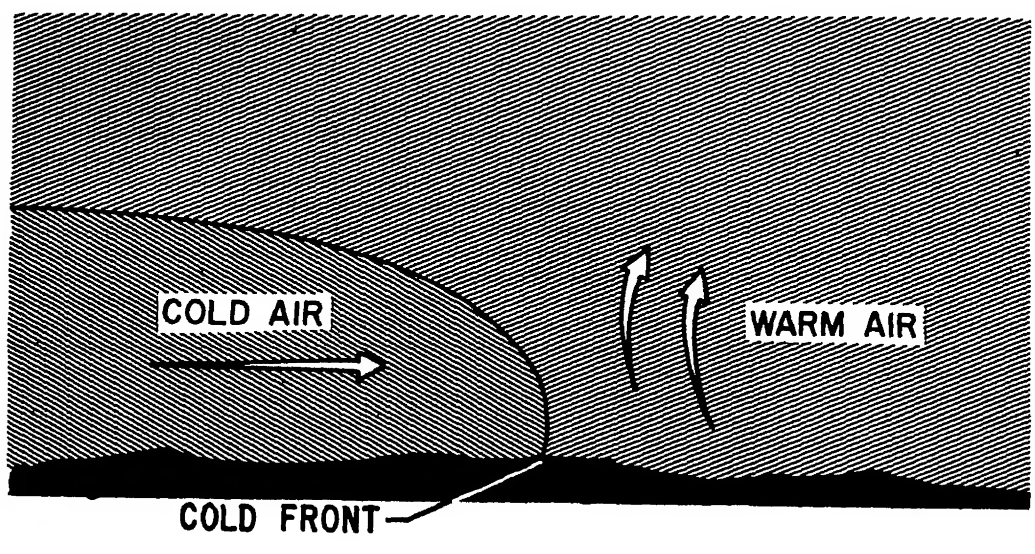

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Figure 3-28.—A cold front.

of cumulonimbus clouds, showers, and thunderstorms is largely dependent on the original instability charactristics of the warm air mass. Within the cold air mass there may be some stratified clouds in the rain area, but there are no clouds beyond this area unless the cold air mass is unstable. In the latter case, some cumulus clouds may develop. This type of front moves with an average speed of 15 knots. (See (A) of figure 3-29.)

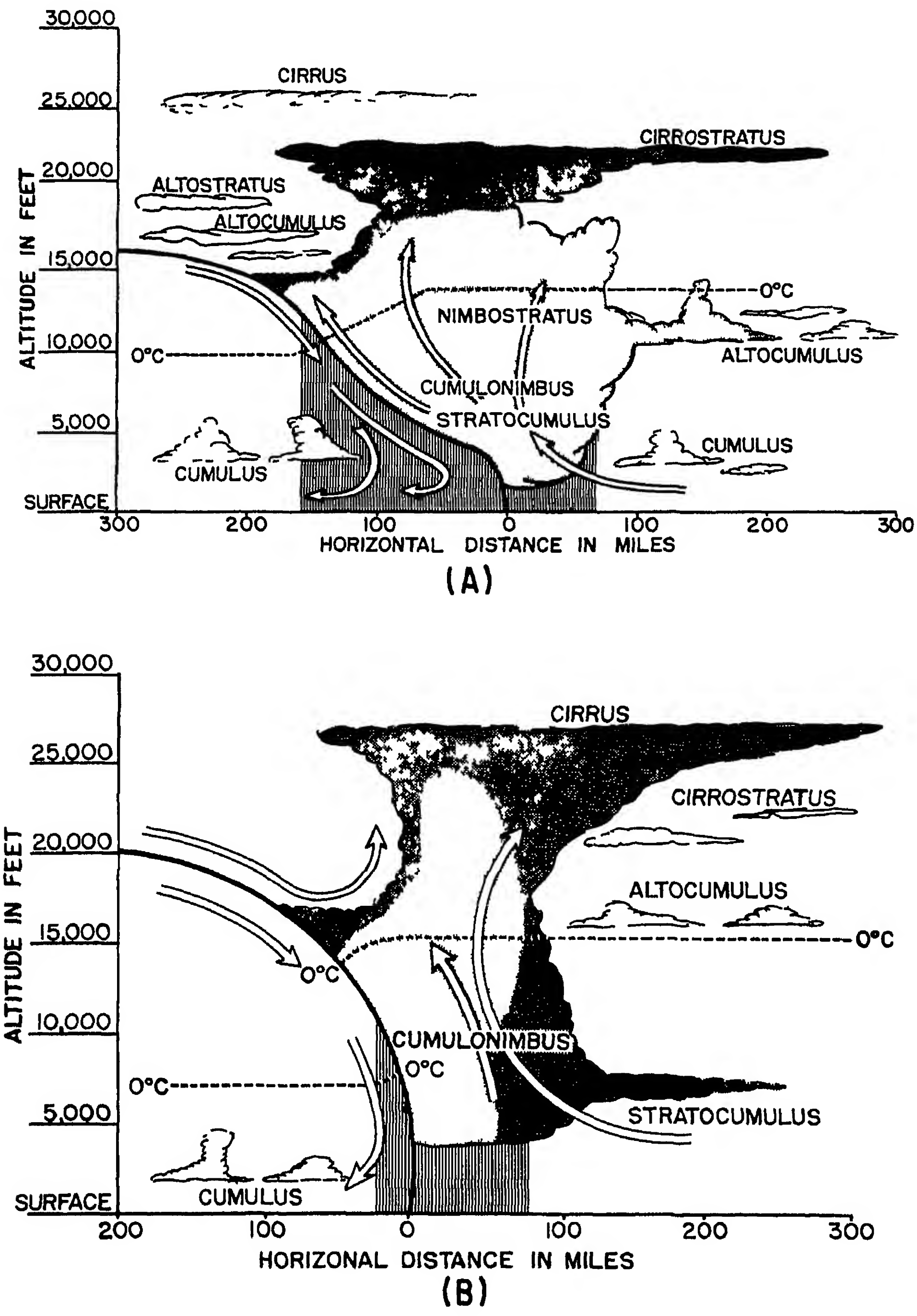

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Figure 3-29.—Vertical cross section of a cold front. (A) slow-moving cold front; (B) fast-moving cold front.

With the fast-moving cold front, there is descending motion of the warm air along the frontal surface at high levels, and the warm air near the surface is pushed vigorously upward. This type of front has a slope of 1:40 to 1:80 and usually moves rapidly; 25 to 30 knots may be considered as an average speed of movement. As a result of these factors, there is a relatively narrow but often violent band of weather. If the warm air mass is conditionally unstable and moist, cumulonimbus clouds, showers, and thunderstorms occur just ahead of and at the surface front, and rapid clearing occurs behind the front. Frequently altostratus and altocumulus cloud layers form and drift ahead of the main cloud bank. The more unstable the warm air mass, the more violent the weather. If the warm air is relatively dry, this type of front may not produce precipitation or clouds. It is with the fast-moving cold front that squall lines and tornadoes are associated. (See (B) of figure 3-29.)

WARM FRONTS

If cold air is retreating before an advancing mass of warm air, the warm air slides over the cold air. The frontal surface in this case is called a warm frontal surface, and its intersection with the earth's surface is called a warm front. (See figure 3-30.)

The weather associated with a warm front varies as it does with a cold front, depending on the degree of stability and moisture of the warm air mass. (See figure 3-31.)

Certain characteristics and weather conditions are associated with the passage of warm fronts. In the Northern Hemisphere the winds veer from southeast to southwest or west, but the shift is not as pronounced as with the cold front. Temperatures are colder ahead of the front and are warmer after passage of the front. Not being greatly affected by daily heating and cooling of the earth's surface, the dewpoint is normally more constant than is the temperature through the day except with the passage of a front. Therefore, the dewpoint is a good index of frontal passage.

A characteristic phenomenon of a typical warm front is the sequence of cloud formations. These formations are noticeable in the following order: cirrus, cirrostratus, altostratus, nimbostratus, and stratus. The cirrus clouds

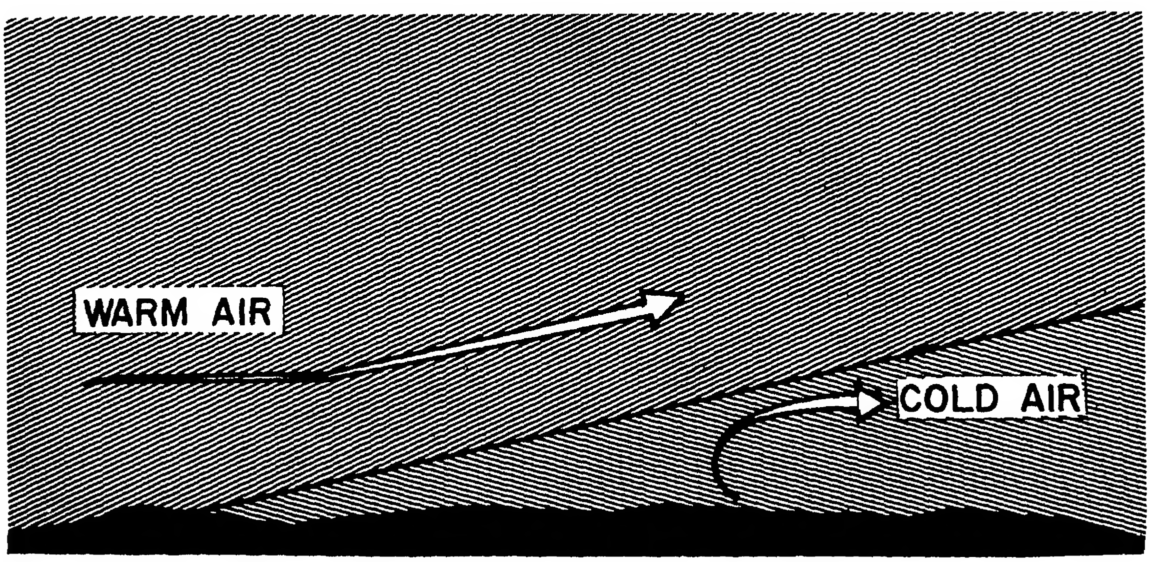

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Figure 3-30.—A warm front.

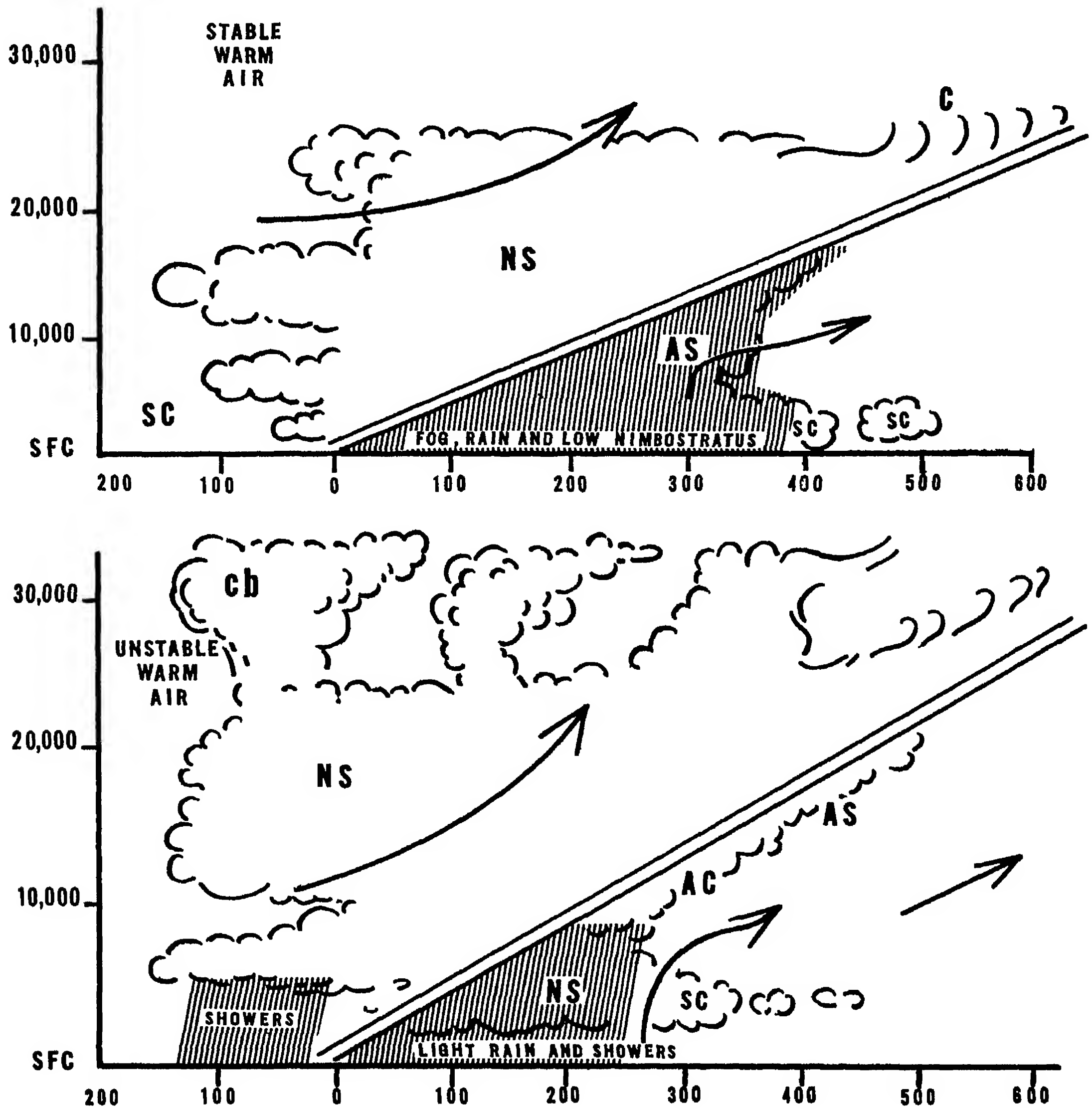

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Figure 3-31.—Vertical cross section of a warm front.

may appear 700 to 1,000 miles ahead of the surface front followed by cirrostratus about 600 miles and altostratus about 500 miles ahead of the surface front. Precipitation in the form of continuous or intermittent rain, snow, or drizzle is frequent as much as 300 miles in advance of the surface front. The precipitation is associated with nimbostratus above the frontal surface and stratus within the cold air. However, when the warm air is convectively unstable, showers and thunderstorms may occur in addition to the steady precipitation.

Clearing usually occurs after the passage of a warm front, but under some conditions drizzle and fog may occur within the warm sector. Normally, the speed of a warm front is less than that of cold fronts; an average may be considered to be about 10 knots.

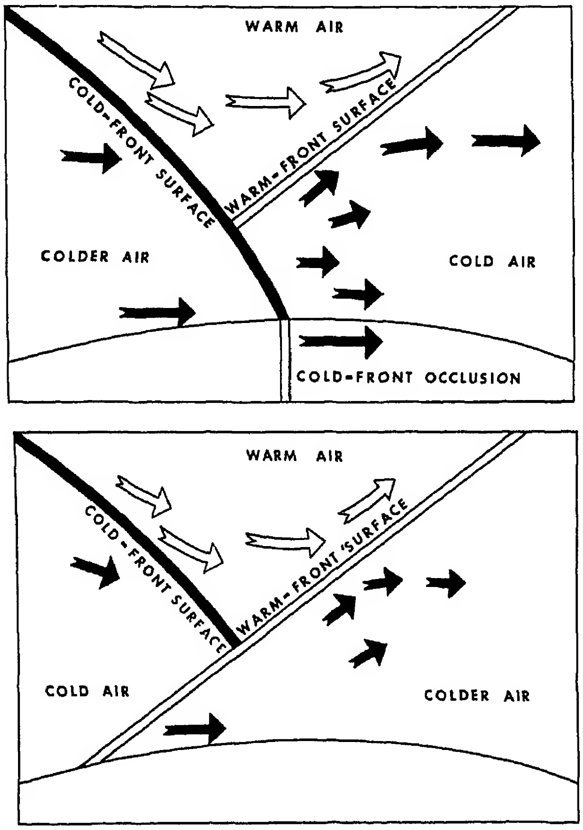

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Figure 3-32.—Vertical cross section of cold- and warm-type occlusions.

OCCLUDED FRONTS

An occluded front occurs when a cold front overtakes a warm front. One of the two fronts is lifted aloft, and the warm air between the fronts is shut off from the earth's surface. An occluded front is often referred to as an occlusion. The type of occlusion is determined by the temperature difference between the cold air in advance of the warm front and the cold air behind the cold front.

If the air in advance of the warm front is colder than the air behind the cold front, the cold front rides along the warm frontal surface and the occluded front is referred to as a warm-type occlusion. If the cold air ahead of the warm front is warmer than the cold air behind the cold front, the cold frontal surface underruns the warm front and the occluded front is called a cold-type occlusion. (See figure 3-32.)

The primary difference between a warm-type and cold-type occlusion is the location of the associated upper front in relation to the surface front. In a warm-type occlusion the upper cold front precedes the surface occluded front by as much as 200 miles. In the cold-type occlusion the upper warm front follows the surface occluded front by 20 to 50 miles.

Since the occluded front is a combination of fronts, the resulting weather is that of the cold front's narrow band of violent weather and the warm front's widespread area of cloudiness and

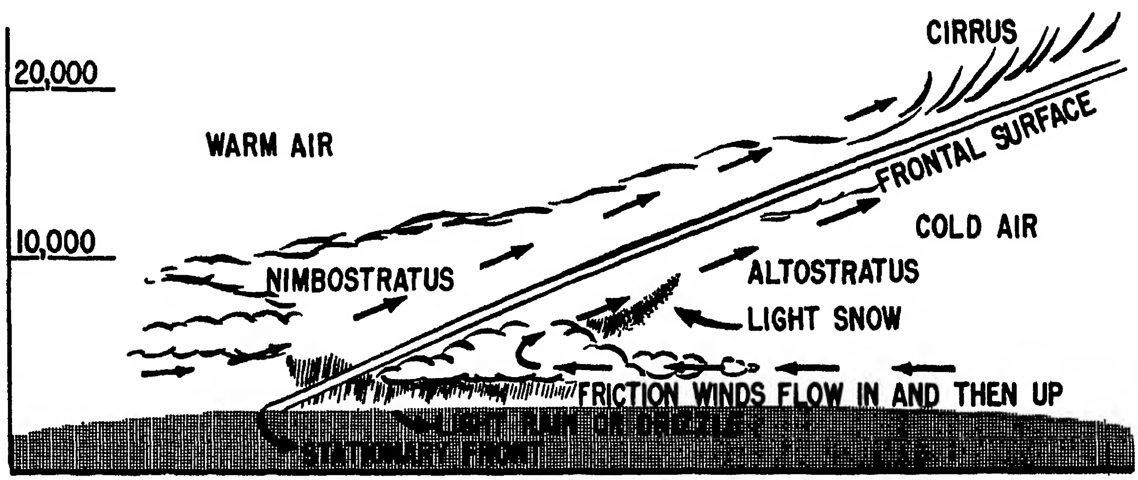

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Figure 3-33.—Cross section of a stationary front.

precipitation occurring in combination along the occluded front. The most violent weather occurs at the tip of occlusion. (The tip is the point at which the cold front is overtaking the warm front.)

STATIONARY FRONTS

One of the most annoying characteristics of a stationary front (a front that shows little or no apparent movement) is that it may greatly hamper and delay air operations by persisting in an area for several days.

The weather associated with a stationary front varies with the stability of the warm air or the moisture content of the cold air. (See figure 3-33.)

If the warm air is unstable, rainfall from thunderstorms normally exists. If the warm air is stable, there generally is drizzle, and beyond the freezing level there are icing conditions, light snow, or light rain. At very high levels there are also some ice-type clouds present.

In the cold air there are generally lowered ceilings and extensive fog. Icing conditions, if present, are light.

The width of the weather band with its precipitation and low ceilings varies from 50 to 200 miles, depending upon the slope of the front and the temperature of the air masses.

EXERCISE

3-8. Assume that you are briefed by the base forecaster that an advancing cold front is to pass through your area in a few hours. What weather conditions would you expect to prevail before passage?

3-9. In the above situation, what type weather would you expect after passage of the front?

3-10. Low ceilings, poor visibility, lingering precipitation, and stratus clouds are all signs of which type of frontal weather?

3-11. A squall line associated with a fast-moving cold front indicates what type of approaching weather?

WEATHER HAZARDS

Learning Objective: **State possible controller operational considerations for certain weather conditions.**

Planning ahead is the name of the game in air traffic control. To plan ahead is to be familiar with all of the weather conditions which can affect control procedures. One of your responsibilities as an AC is to assist pilots in avoiding weather hazards. To aid you in this service, a review of the primary hazards of weather to aviation is covered in this section. It includes: restrictions to visibility, aircraft icing, turbulence, and thunderstorms.

In general, weather conditions depend greatly upon the amount of water in the air. The water may be in any of three forms—gas, liquid, or solid. As a gas, it is called water vapor, which is invisible. In a liquid or solid form, it is called a hydrometeor. Hydrometeors are water particles which are either falling through or suspended in the atmosphere, blown from the surface by wind, or deposited on objects. Hydrometeors comprise all forms of precipitation, such as rain, drizzle, snow, and hail, and such elements as clouds and fog.

Most of the weather that interferes with the operation of aircraft is directly associated with water in some form. Before proceeding, you need a working knowledge of the characteristics of water vapor because it is a necessary part of the atmosphere.

WATER VAPOR

Any given volume or amount of atmosphere at a given temperature can contain only a certain maximum quantity of water vapor. If more and more water vapor is injected into a volume of air

which is kept at a constant temperature, a point is reached when the water vapor condenses (becomes liquid). At this point, the volume of air is said to be saturated and such elements as fog or dew are formed. If the temperature increases, more vapor must be injected before the saturated state is reached and condensation occurs. On the other hand, cooling a saturated volume of air forces some of the vapor to condense and the quantity of vapor in the volume diminishes.

Although the major portion of the atmosphere is not saturated, it is desirable to be able to say how near it is to being saturated. This relationship is expressed as "relative humidity." The relative humidity of a volume of air is the ratio (in percent) between the water vapor actually present and the water vapor necessary for the saturation at a given temperature and pressure. Relative humidity shows the degree of saturation, but it gives no clue as to the actual amount of water vapor in the air. Thus, other expressions of humidity are useful.

The "dewpoint" is the temperature to which air must be cooled, at constant pressure and constant water vapor content, in order for saturation to occur. When the atmospheric pressure stays constant, the dewpoint reflects increases and decreases in moisture in the air. The more water vapor present, the higher the dewpoint. Thus, the difference between the temperature and dewpoint is really an index of the amount of water vapor present in the air at a given pressure. This difference also shows at a glance how much cooling of the air might result in condensed moisture.

RESTRICTIONS TO VISIBILITY

There are various types of obstructions to vision, each of which has a direct bearing on control of aircraft. Hydrometeors are one type. Some others are lithometeors and electrometeors. Lithometeors, in contrast to hydrometeors which consists largely of water, are composed of solid dust or sand particles, or the ashy products of combustion. Electrometeors are such phenomena as the lightning associated with thunderstorms and auroras.

Fog

Since your job as an air traffic controller is primarily one of helping pilots by relaying known and anticipated information to them, it is essential that you have a fundamental knowledge of the classes and causes of fog.

Fog may be defined as a cloud on the earth's surface. It is a visible condensation in the atmosphere of sufficient density to interfere with visibility.

Fog consists of visible water droplets or ice particles suspended in the atmosphere. It differs from other clouds in that it exists on the ground or over the surface of bodies of water. It differs from rain or mist in that its water or ice particles are more minute, are suspended, and do not fall earthward.

At times when conditions are favorable for fog, a very low cloud layer may form. This is especially true over flat terrain when surface winds exceed 15 knots. These fog-like clouds form in stable air and often exist together with fog. In this case there is no real line of distinction between the fog and the stratus cloud. One merges gradually into the other, and the ceiling reported by the weather observer is the vertical visibility from the surface into the fog.

FORMATION OF FOG.—The difference between the dewpoint and the temperature is used in the prediction of fog formation. The smaller the difference between the temperature and dewpoint, the greater the possibilities of fog formation. Spread is the term used to define the difference in degrees between the two. All ACs should be alert to the possibility of fog formation whenever the spread decreases to four degrees or less.

There are two ways in which the temperature and dewpoint may become coincident:

1. The dewpoint rises until it equals the temperature. This results from the addition of water vapor to the air by evaporation from water surfaces, wet ground, or precipitation falling through the air.
2. The temperature lowers to the dewpoint as a result of cooling of the air by contact with a cold surface underneath.

Naturally, other factors influence the formation of fog. Wind is one. In a calm condition, fog will form and is generally very shallow. However, a light wind condition is ideal for fog formation, as it produces deep layers of fog. A moderately strong wind tends to keep fog from forming as it circulates the air too rapidly for fog-producing conditions to exist. Strong wind will often dissipate fogs already formed.

Air polluted with dust and smoke particles provides a great quantity of condensation nuclei. These nuclei, offering particles of matter upon which moisture may condense are necessary in order that condensation will take place, thus enhancing the formation of dense fog. Although all fog can reduce the ceiling and visibility to near zero, the most dangerous type of fog is one that covers large areas.

CLASSES.—Fog is divided into two classes: air mass fog and frontal fog. Each class is discussed as there are different requirements which govern the formation of each class.

Air mass fog occurs within a given air mass and is formed when the layer of air close to the earth's surface is cooled by contact with a colder surface below.

There are four types of air mass fog. Each type gets its name from the particular manner in which air is cooled to the dewpoint or saturated to condensation. The four types are radiation fog, advection fog, upslope fog, and steam fog.

Radiation fog, which generally occurs as ground fog, is formed by the cooling of a land surface on clear nights by radiation of heat to the sky. (See figure 3-34.) Radiation fog never forms over water.

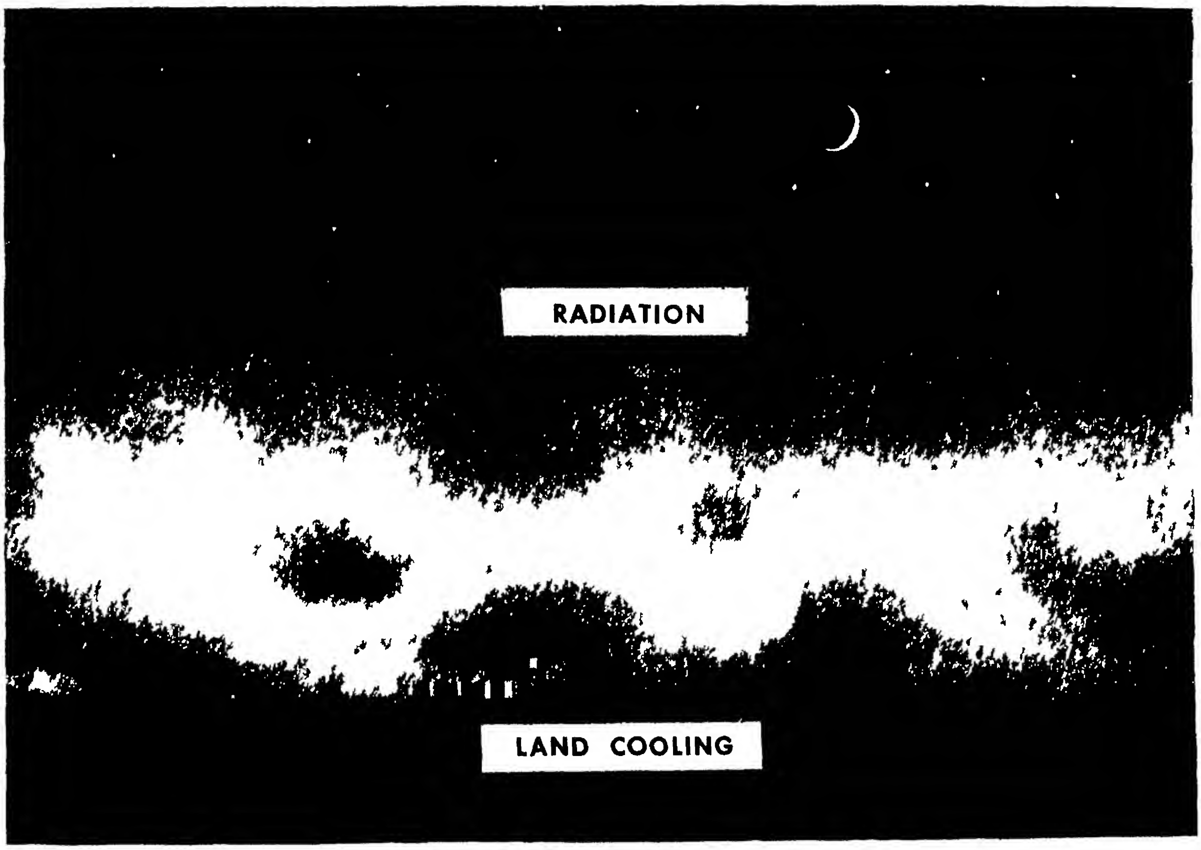

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Figure 3-34.—Radiation fog.

After sunset, the earth receives no heat from the sun, but continues to radiate heat. The surface begins to cool because of this heat loss. As the earth cools, the layer of air next to the earth's surface is cooled by conduction. If the layer of air next to the surface is sufficiently moist, the conduction progress chills the air to the dewpoint temperature and fog forms. In case of a calm wind, this cooling by conduction affects only a very shallow layer of air. In this case, the fog tends to be very thin. Wind from three to five knots provides enough mixing so that the fog will be fairly deep. If the wind is too strong, it causes so much mixing that fog does not form. Radiation fog usually forms at night and generally dissipates before midmorning. The best condition for radiation fog is a clear cool night, light wind, and high humidity.

Advection fog is the name given to fog produced by air in motion or fog formed in one place and transported to another. This type of fog is formed when air is transported over a land or water surface colder than the air mass passing over it. (See figure 3-35.) Cooling from below takes place and gradually builds up a layer of fog.

Advection fog forms in regions where marked temperature contrasts exist within a short distance of each other, and only when the wind blows toward the cold region. Areas of marked temperature contrast are usually found along the coastlines, places where snow-covered ground is adjacent to bare ground, and at sea where cold and warm water currents are adjacent.

Because advection fog covers larger areas than the other types, it is generally considered the most dangerous type.

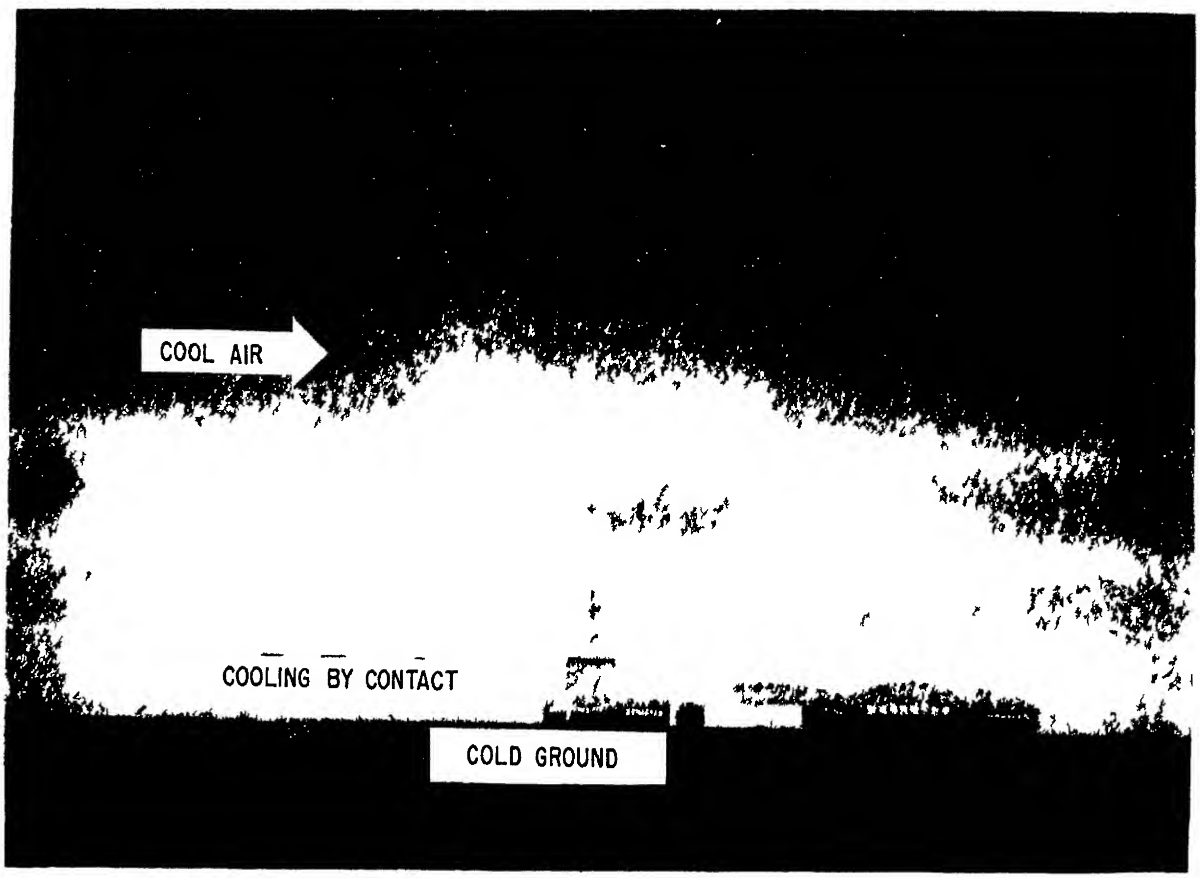

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Figure 3-35.—Advection fog.

Upslope fog forms when air is forced to ascend a gradual slope. As the air rises up the slope, the atmospheric pressure decreases causing the air to expand and cool. If the air cools to a temperature equal to the dewpoint temperature, fog will form. Upslope fog forms in very deep layers and requires considerable time to dissipate. The most common fog of this type is called Cheyenne fog and is caused by the westward flow of air from the Missouri valley, which produces fog on the eastern slope of the Rocky Mountains. (See figure 3-36.)

Steam fog, sometimes referred to as sea smoke, occurs within air masses. However, unlike other air mass fogs which are formed by cooling of the air temperature to the dewpoint temperature, this type is caused by saturation of the air through evaporation of water. It occurs when cold air moves over warm water. Evaporation from the surface of the warm water easily saturates the cold air, causing the fog to form. This type of fog is most common in the northern latitudes. Marsh or swamp mist is a familiar example of steam fog. This type of fog generally forms in the fall of the year only. (See figure 3-37.)

Frontal fog is another hazard which must be added to the list of weather troubles associated with fronts. Frontal fog forms under the frontal surface in the cold air mass. Frontal fog is divided into two classes: warm front fog and cold front fog.

The warm front fog is much more extensive than the cold front type and is a definite hazard to flight operations. It is caused by rain falling from warm air into the cold air beneath the front and is anticipated by a rise in the dewpoint to or very near to the free air temperature. (See figure 3-38.)

Since the precipitation band accompanying a warm front is quite wide and the movement of the front is slow, this warm front fog may cover an extensive area for considerable time. After the passage of a warm front, an advection type fog frequently occurs in the warm air if the surface is much colder than the air that is moving in. Strictly speaking, this is not a frontal type fog, but is formed within the air mass itself by advection cooling.

Warm front fog is particularly prevalent along the eastern seaboard of the United States, where the cold waters offshore and the general upslope of the terrain are contributing factors toward this fog formation.

Cold front fog is comparatively rare because cold fronts move so rapidly and have associated with them such narrow bands of precipitation and high wind speeds that fog conditions dissipate or

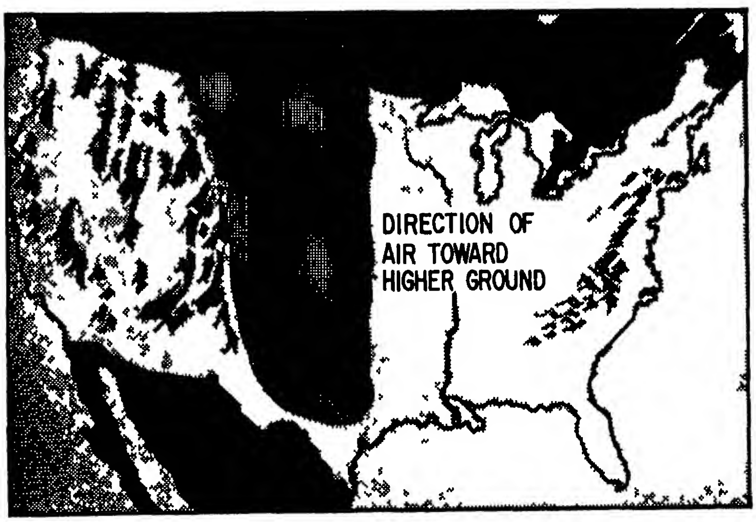

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Figure 3-36.—Upslope fog.

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Figure 3-37.—Steam fog.

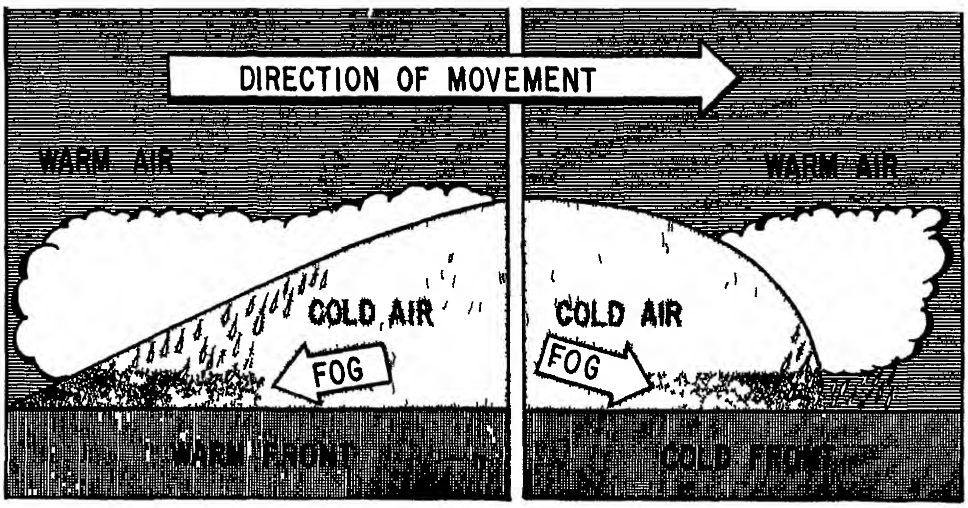

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Figure 3-38.—Warm- and cold-front fog.

lo not develop. On some infrequent occasions, 'og does form in the cold air mass just behind the ;old front. (See figure 3-38.) When this happens, he fog dissipates rapidly due to the fast novement of the front over the surface of the :arth.

ᵓrecipitation

Precipitatıon includes all forms of moisture hat fall to the earth's surface. Snow, drizzle, and ain are the most common forms of precipitation :ausing restrıctions to visibility. Of these, snow s usually the most effective in reducing visibility. Ⅎeavy snow and blowing snow frequently reduce ;urface and slant visibility to near zero. Rain 'arely reduces surface visibility to below one mile ınd has a tendency to wash dust, smoke, and even 'og particles out of the air. Conversely, drizzle ›ften accompanies fog, haze, and smoke, esulting in lower visibility than rain.

Lithometeors

Lithometeors comprise a class of atmospheric ›henomena, among which dry haze and smoke ıre the most common examples.

Haze is a concentration of dust or salt particles within a stable layer of the atmosphere that ›ccasionally may extend from the surface upward o 15,000 feet. Haze layers often have definite tops ıbove which air-to-air visibility is good. However, ıir-to-ground visibility above the haze layer is ›oor, especially on a slant. Smoke restricts ⁄isibility in a manner similar to haze. Smoke ;ometimes is concentrated in layers aloft with ;ood visibility beneath the smoke.

Strong surface winds and vertical currents in ınstable air carry aloft loose materials from the ;urface such as dust and sand. These conditions, ike blowing snow, can reduce surface visibility o near zero over extensive areas. Under favorable :onditions, dust can be carried aloft to 15,000 feet ınd restrict slant, flight, and surface visibility. Sand and snow seldom are carried aloft beyond ı few hundred feet.

[CING

Another weather hazard to flying is airframe ıcing. The AC who has exact knowledge of when and how ice forms on aircraft is able to lend invaluable assistance to pilots at one time or another.

Formation of ice on an aircraft reduces lift and thrust by adding weight to the structure and changing the airfoil shape of wings, tail, and propeller(s). There are three types of airframe ice: rime, clear (glaze), and frost. Icing conditions encountered in flight are a combination of rime and clear ice types with the characteristics of one or the other being dominant. Frost usually forms on aircraft while on the ground. An everday comparison between rime ice and clear ice may be found in a home refrigerator. The ice that forms in the ice tray is an example of clear ice. It is very hard and glassy, and can be broken loose only with difficulty. Rime ıce is the ice that forms on the refrigerator's coils. It is white and granular, and can be easily broken off. There are only two fundamental conditıons necessary for the formation of ice on aırcraft in flight. The aircraft must be flying through visible water in the form of rain, drizzle, or cloud droplets; and at the time the water droplets strike the aircraft, their temperature, and the temperature of the surface of the aircraft, must be 32 °F or colder. The heaviest airframe icing will generally occur within the temperature range of 0 °C to −10 °C (32 °F to 15 °F) provided moisture is available.

Clear Ice

Clear ice, sometimes referred to as glaze ice, is considered to be the most serious of the three types. It is clear, dense, and solid; adhering firmly to structures upon which it forms. (See figure 3-39.) If the water droplets strike an aircraft in such rapid succession that none has a chance to freeze before the next strikes in the same place, the leading edges of the aircraft structures are kept covered by a film of liquid water. This film of water, cooled by contact with the colder air and by partial evaporation, freezes from the inside out forming a clear, dense, strong layer of ice attached to the wing or other surfaces upon which it is freezing.

Some of the conditions which produce a liquid film of water on aircraft favorable to the formation of clear ice are as follows:

1. Large water droplets such as found in cumuliform clouds

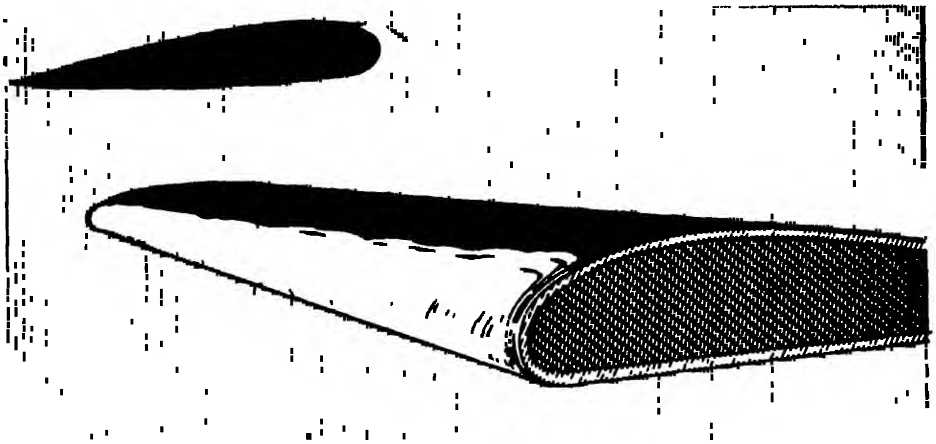

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Figure 3-39.—Clear ice on an airfoil.

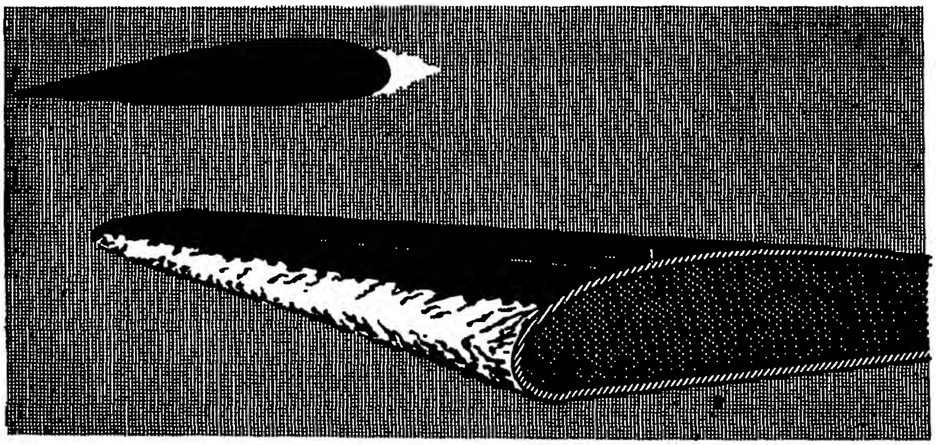

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Figure 3-40.—Rime ice on an airfoil.

2. Large number of cloud droplets (dense clouds)

These first two conditions are most commonly found in unstable air.

3. Temperature just slightly below freezing
4. An unstable or conditionally unstable air mass
5. Rain or freezing rain.

Rime Ice

Rime ice is a granular, whitish, opaque, rough deposit of ice formed from tiny super-cooled water drops found in the stratiform clouds of stable air. (See figure 3-40.) Rime ice usually occurs at a lower temperature than does clear ice.

Unlike clear ice, rime is formed as each super-cooled water droplet that strikes the airfoil freezes completely before another strikes in the same

place. The resulting ice deposit is in the form of tiny pellets frozen together in a spongy mass.

The conditions which favor formation of rime ice are as follows:

1. Very small droplets such as found in stratiform clouds
2. A relatively small number of water droplets found in clouds that are not dense
3. Temperatures far below freezing
4. An air mass that is stable or conditionally stable
5. Drizzle.

Frost

Frost is a light, whitish, feathery crystalline structure, snowlike in character. It forms a dangerous coating on an aircraft surface which adds drag and alters the aerodynamic characteristics of an aircraft. Frost occurs when the temperatures of the surfaces of the aircraft are below freezing at the time condensation takes place. This icing condition usually forms on aircraft on the ground. It can also form on airborne aircraft if the aircraft very quickly flies from a region where the temperature is well below freezing to a region where the temperature is considerably higher and the air is very moist.

Other parts of the aircraft susceptible to icing which will decrease its flight capabilities are the propeller, pitot tube, and carburetor. Propeller ice reduces the power of the aircraft; pitot tube ice causes malfunction of the air speed indicator; and carburetor ice gives the effect of slowly closing the throttle. It occurs under a wide range of temperatures and can result in complete engine failure. Carburetor ice forms during vaporization of fuel combined with the expansion of air as it passes through the carburetor. Temperature drop in the carburetor can be as much as 40 °C, but is usually 20 °C or less. The temperature at which carburetor icing will form depends upon many factors such as relative humidity, type of gas and its ingredients, and the type of carburetors.

Icing Intensities

Your responsibility as an AC is to keep pilots informed of areas where icing has been reported, provide assistance in avoiding those areas, and give priority to handling the affected aircraft when necessary.

By mutual agreement and for standardization, the FAA, the NWS, and military aviation services have classified aircraft icing into four intensities. The following describes how icing intensities are reported:

1. Trace—Ice becomes perceptible. Rate of accumulation is slightly greater than the rate of sublimation. It is not hazardous even though deicing/anti-icing equipment is not utilized, unless encountered for an extended period of time (over 1 hour).

2. Light—The rate of accumulation may create a problem if flight is prolonged in this environment (over 1 hour). Occasional use of deicing/anti-icing equipment removes/prevents accumulation. It does not present a problem if the deicing/anti-icing equipment is used.

3. Moderate—The rate of accumulation is such that even short encounters become potentially hazardous and use of deicing/anti-icing equipment or flight diversion is necessary.

4. Severe—The rate of accumulation is such that deicing/anti-icing equipment fails to reduce or control the hazard. Immediate flight diversion is necessary.

TURBULENCE

One of the unseen and most dangerous conditions to aircraft is turbulence. The effects of turbulence on aircraft ranges all the way from a few annoying bumps to severe jolts. Some types of turbulence have caused aircraft to break up and disintegrate while in flight. Your job as an AC requires that you collect data on turbulence and issue advisories as appropriate.

There are two types of turbulent conditions of which you should be aware. These conditions are turbulence that is associated with natural and weather phenomena and turbulence that is man-made. Naturally caused turbulence may exist with or without cloud conditions. Turbulence in clouds, such as associated with thunderstorms, is extremely dangerous. Turbulence is reported in varying degrees of intensity. The classification of intensities are light, moderate, severe, and extreme.

Natural Turbulence

In general, turbulence can be approached from the standpoint of causative factors. For the purpose of this discussion, we are going to divide natural turbulence into the following causative factors:

1. Thermal. This is caused by localized vertical air movements; these movements occur when cold air is moving over warmer ground or when the ground is strongly heated by the sun. The amount of thermal current depends on several things; but, in general, barren surfaces cause stronger currents than grass-covered ones.
2. Mechanical. When air near the surface flows over obstructions, such as irregular terrain and buildings, the wind flow is disturbed and is transformed into irregular movements.
3. Frontal. This is caused by the lifting of warm air by moving cold fronts. The most severe turbulence is caused by fast-moving cold fronts which contain moist air.
4. Wind shears. A change in either wind speed or direction is referred to as a shear. The greater the change, the more severe the turbulence. This type of turbulence may occur in perfectly clear air without any visual warning. It is often referred to as clear air turbulence (CAT). An extreme form of wind shear that is of considerable importance to aircraft operations sometimes forms close to the surface. An example of this is found when a pocket of cold air remains near the surface while the air above it has remained warm. Between the two layers, a narrow band of very turbulent air forms. Aircraft passing through this area often encounter considerable turbulence.

Man-made Turbulence

The form of man-made turbulence that we are referring to is wake turbulence. Wake turbulence is prevalent in airport terminal areas since it is produced by arriving or departing aircraft. Wake turbulence can be severe enough to result in complete loss of control by the pilot of a succeeding aircraft. You can understand how important it is to advise concerned pilots of any form of turbulent conditions. We refer your study to Chapters 5 and 10 of this manual and the FAA handbook 7110.65 for the exact phraseology and procedures to follow. Remember that the greatest strength of wake turbulance occurs when an aircraft is HEAVY, CLEAN, and SLOW, and starts when the aircraft rotates upward for takeoff and ends at the point where the aircraft lands.

Degrees of Turbulence

As we stated previously, turbulence is classified by degrees. In order to further clarify this discussion, we present the following brief description of these degrees:

1. Light turbulence—Momentarily causes slight changes in altitude and/or attitude (pitch, roll, or yaw).
2. Moderate turbulence—Similar to light turbulence, but of greater intensity, and the aircraft remains under control. NOTE: At times, a pilot will report light or moderate chop. This refers to a type of turbulence that causes a rhythmic bumpiness with little attitude change. This term is used only with light or moderate turbulence.
3. Severe turbulence—Causes large abrupt changes in altitude and/or attitude. Aircraft may be momentarily out of control.
4. Extreme turbulence—Aircraft is being violently tossed about and is practically out of control.

In any case of reported turbulence, be sure to relay the information to other pilots in the area and the base weather station for dissemination. In dealing with turbulence the aircraft type is of importance, so be sure to obtain this information; and, when issuing a turbulence report, include the type of the reporting aircraft. Obviously, a report of moderate turbulence being reported by a CESSNA pilot would cause little concern to a C5A pilot.

THUNDERSTORMS

Thunderstorms are electrometeors. An electrometeor is a visible or audible manifestation of atmospheric electricity. The thunderstorm represents a violent and spectacular atmospheric phenomenon. Thunderstorms (cumulonibus clouds) are always accompanied by lightning

and thunder. Thunderstorms are particularly dangerous for pilots because they are almost always accompanied by strong gusts of wind, severe turbulence, and icing. Heavy rain normally accompany the thunderstorm and hail is not uncommon. As an Air Traffic Controller, you frequently must relay thunderstorm information to a pilot and occasionally must advise or assist a pilot on thunderstorm avoidance. Since approximately 44,000 thunderstorms occur daily over the surface of the earth, however, a pilot will sometimes have to fly through a thunderstorm or a thunderstorm area. The turbulence within most thunderstorms is considered one of the worst hazards of flying.

The National Weather Service recognizes only two classes of intensities of thunderstorms as applied to aviation weather observations: (1) thunderstorms "T", and (2) severe thunderstorm "T+". The National Weather Service radar systems are able to objectively determine radar weather echo intensity levels by use of Video Integrator Processor (VIP) equipment. These intensity levels are on a scale of one to six. (See RADAR WEATHER ECHO INTENSITY LEVELS in the Pilot/Controller Glossary—Appendix B).

Formation

A certain combination of atmospheric conditions is necessary for the formation of a thunderstorm. These factors are conditionally unstable air of relatively high humidity and some type of lifting action. Before the air actually becomes unstable, it must be lifted to a point where it is warmer than the surrounding air. When this condition is brought about, the relatively warmer air continues to rise freely until, at some point aloft, its temperature has cooled to the temperature of the surrounding air. In order to bring the warm surface air to a point where it will continue to rise freely, some type of external lifting action must be introduced. Many conditions satisfy this requirement. For example, an air mass may be lifted by heating, terrain, and fronts or convergence.

Structure

The fundamental structural element of the thunderstorm is the unit of convective circulation known as a convective cell. A mature thunderstorm contains several of these cells, which vary in diameter from 1 to 6 miles. By radar analysis and measurement of drafts, it has been determined that, generally, each cell is independent of surrounding cells of the same storm. Each cell progresses through a cycle which lasts from 1 to 3 hours. In the initial stage (cumulus development), the cloud consists of a single cell; but as the development progresses, new cells form and older cells dissipate.

The life cycle of the thunderstorm cell consists of three distinct stages; they are the cumulus stage, the mature stage, and the dissipating or anvil stage. (See figure 3-41.)

CUMULUS STAGE.—Although most cumulus clouds do not become thunderstorms, the initial stage of a thunderstorm is always a cumulus cloud. The chief distinguishing feature of this cumulus or building stage is an updraft, which prevails throughout the entire cell. Such updrafts vary from a few feet per second to as much as 100 feet per second in mature cells.

MATURE STAGE.—The beginning of surface rain, with adjacent updrafts and downdrafts, initiates the mature stage. By this time the apex of the average cell has attained a height of 25,000 feet or more. As the raindrops begin to fall, the frictional drag between the raindrops and the surrounding air causes the air to begin a downward motion. The descending saturated air soon reaches a level where it is colder than its environment; consequently, its rate of downward motion is accelerated. This is a downdraft.

DISSIPATING (ANVIL) STAGE.—Throughout the life span of the mature cell, more and more air aloft is being dragged down by the falling raindrops. Consequently, the downdraft spreads out to take the place of the dissipating updraft. As this process progresses, the entire lower portion of the cell becomes an area of downdraft. Since this is an unbalanced situation, and since the descending motion in the downdraft effects a drying process, the entire structure begins to dissipate. The high winds aloft have now carried the upper section of the cloud into the anvil form, indicating that gradual dissipation is overtaking the storm cell.

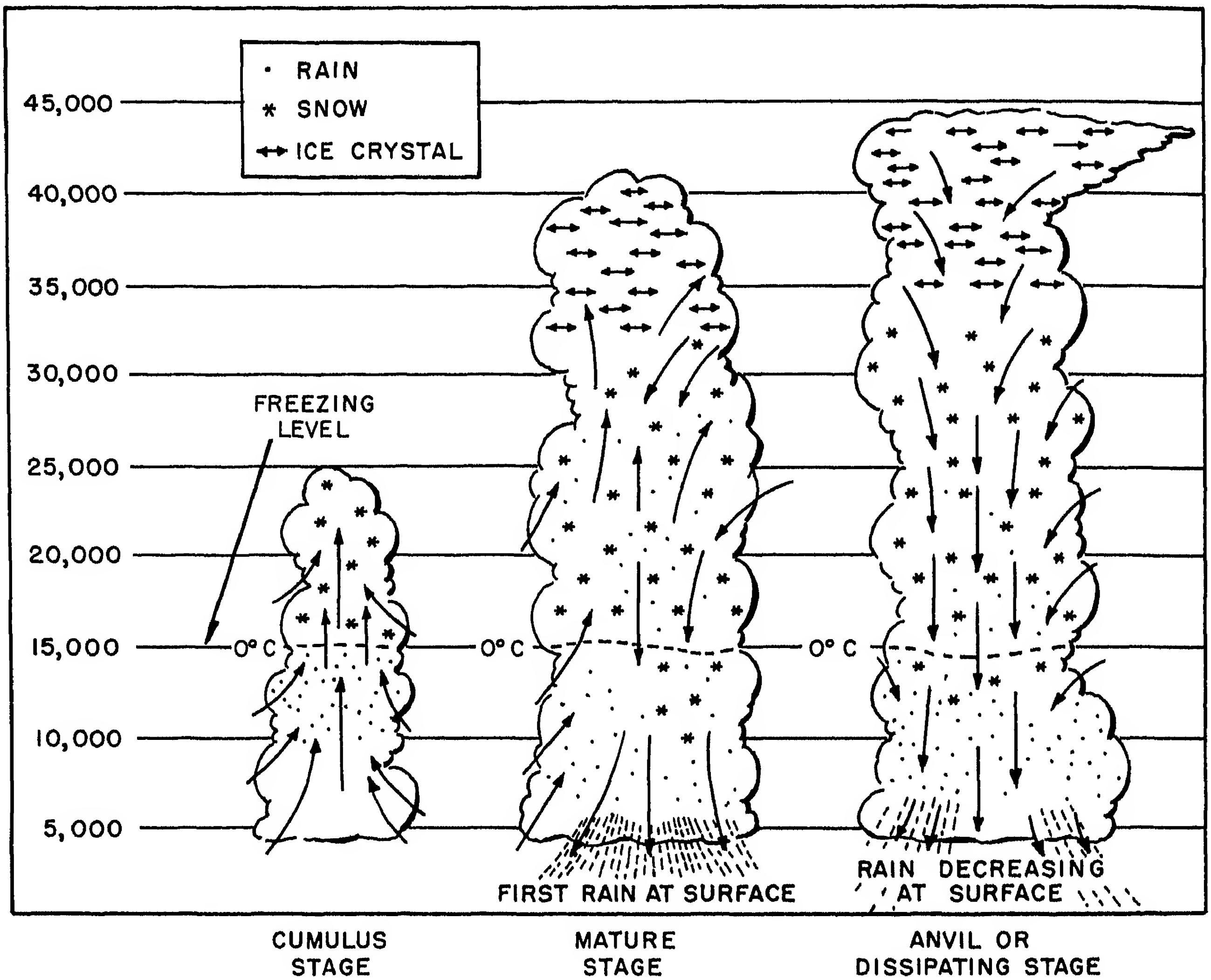

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Figure 3-41.—Life cycle of a thunderstorm cell.

Thunderstorm Weather

RAIN.—Liquid water in a storm may be ascending if encountered in a strong updraft; it may be suspended, seemingly without motion, yet in extremely heavy concentrations; or it may be falling to the ground. Rain, as normally measured by surface instruments, is associated with the downdraft. This does not preclude the possibility of a pilot entering a cloud and being swamped, so to speak, even though rain has not been observed from surface positions. Rain is found in almost every case of cloud penetration below the freezing level. In instances in which no rain is encountered, the storm probably has not developed into the mature stage.

HAIL.—Hail is a possibility in any thunderstorm, and the presence of damaging hail should always be considered with moderate or severe storms.

TURBULENCE.—Data obtained by research indicates that the frequency and severity of

turbulence encountered decrease slowly with distance from the storm cores. Moderate to severe turbulence may be encountered up to 20 miles from the center of severe storms at any altitude and up to 10 miles from the centers of less severe storms. Severe turbulence is often found in the anvil cloud 15 to 20 miles downwind from the severe storm cores. The storm cloud is only the visible portion of a turbulent system whose updrafts and downdrafts often extend outside of the storm proper. Very little evidence exists that maximum turbulence occurs at the middle heights of a storm. The same turbulence considerations which apply to flight at high altitudes near storms apply to low altitudes as well. No useful correlation exists between the external visual appearance of thunderstorms and the turbulence and hail within them.

LIGHTNING.—The electricity generated by a thunderstorm is rarely a great hazard to aircraft from the standpoint of airframe, but its hazards include:

1. Temporary blindness during hours of darkness
2. Damage to navigational and eletronic equipment
3. Punctures in the aircraft skin from direct lightning strikes

ICING.—Both rime and clear icing may be encountered. Clear ice accumulation in thunderstorms above the freezing level can be so rapid that an aircraft may become incapable of maintaining level flight.

Since the freezing level is also the zone of greater frequency of heavy turbulence and generally heavy rainfall, this particular altitude or level appears to be the most hazardous.

EFFECT ON ALTIMETERS.—Pressure usually falls rapidly with the approach of a thunderstorm. It rises sharply with the onset of the first gusts and the arrival of the cold downdraft and heavy rain showers. The pressure then falls back to the original pressure as the rain ends and the storm moves on. This cycle of pressure change may occur in 15 minutes. The altitude indicated on an altimeter during the heavy rain may be in error by over a hundred feet a few minutes after the rain stops.

SURFACE WIND.—A significant hazard associated with thunderstorm activity is the rapid change in surface wind direction and speed immediately prior to storm passage. The strong winds at the surface accompanying a thunderstorm passage are the result of the horizontal spreading out of downdraft currents from within the storm as these currents approach the surface of the earth.

The total wind speed is a result of the downdraft divergence plus the forward velocity of the storm cell. Thus, the speeds at the leading edge, as the storm approaches, are greater than those at the trailing edge. The initial wind surge, as observed at the surface, is known as the first gust.

The speed of the first gust is normally the highest recorded during storm passage, and the direction may vary as much as 180 degrees from the previously prevailing surface wind. First-gust speeds increase to an average of about 16 knots over prevailing speeds, although gusts of over 78 knots (90 mph) have been recorded. The average change of wind direction associated with the first gust is about 40 degrees.

DENSITY ALTITUDE

Temperature and pressure together form the basis for determining the density altitude. Density altitude is the pressure altitude (the distance measured above or below the 29.92-inch pressure level) corrected for temperature. The density altitude is used by pilots to compute takeoff and climb performance of an aircraft. There is an extreme difference in takeoff performance resulting from increased temperature. (See figure 3-42.) Therefore, during hot weather, you must remember that more runway separation is going to be required due to the increase in takeoff roll. You should also remember that the climb rate of an aircraft is also diminished by high temperature. High density altitude (light air) affects three phases of aircraft performance:

(1) Engines develop less power.

(2) Propellers develop less thrust.

(3) Wings develop less lift.

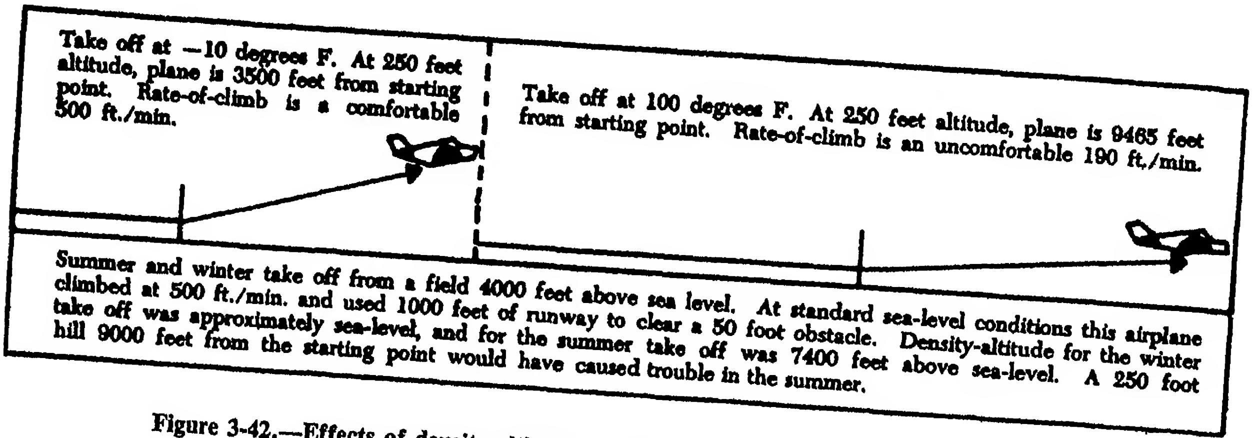

Figure 3-42.—Effects of density altitude on takeoff and climb performance of aircraft.

EXERCISE

3-12. Define relative humidity.

3-13. Define dewpoint.

3-14. What two elements are used in the prediction of fog formation?

3-15. Which type of fog is considered to be the most dangerous?

3-16. Why is aircraft icing so dangerous?

3-17. Which type icing is the most serious?

3-18. List the four intensities of icing.

3-19. What are the two classes of turbulence?

3-20. A band of turbulence between two layers of different temperature air is called ______.

3-21. List the four degrees of turbulence.

3-22. What type of turbulence is "chop"?

3-23. Why are thunderstorms considered so dangerous for pilots?

3-24. What are the two classes of thunderstorms?

3-25. What are the (a) three stages of a thunderstorm and (b) which is associated with the most severe weather?

3-26. Give two operational considerations and/or probable controller actions for each of the following weather conditions:

a. Clear, hot, dry day.

b. Local areas of intense glaze icing.

c. Local areas of moderate turbulence, hail, and electrical discharges.

CHAPTER 4

AVIATION WEATHER REPORTS, FORECASTS, AND ADVISORIES

The weather information that is most often used by Navy weather personnel, pilots, and controllers alike is contained in hourly aviation weather reports, forecasts, and advisories. A weather report is a statement of weather conditions that exist at a given time. A forecast is a prediction of weather conditions expected at some future time. A weather advisory contains information on existing or forecasted conditions considered to be a potential hazard to aircraft in flight.

All weather reports, forecasts, and advisories are prepared in standard formats for distribution, and are encoded using numerals, symbols, and contractions. This coding saves time and space on weather reporting circuits. You, as an Air Traffic Controller need not know all of the details involved in preparing hourly weather reports, forecasts, or advisories, but you must know how to decode this important information and how to relay it to pilots.

AVIATION WEATHER SERVICE

Learning Objective: **Identify the activities which provide weather service to pilots, and the methods used to distribute weather information.**

The National Weather Service (NWS) is the agency responsible for the nation's aviation weather service. It is the primary organization for providing weather service to pilots. To prepare, collect, and transmit the thousands of observations and forecasts now available to pilots would require an organization many times the size of the National Weather Service. Therefore, the NWS obtains the cooperation of other government agencies, private individuals, and organizations to satisfy the overwhelming aviation weather service requirements.

The Federal Aviation Administration (FAA) is considered the principal distribution agency for weather information to airmen through it's vast communication systems and pilot weather briefing service.

The military weather services, Naval Oceanography Command (Navy) and Air Weather Service (Air Force), cooperate extensively with the NWS at all levels by the exchange of weather information. However, the military weather services concentrate their efforts toward satisfying military requirements and directly serve military interests.

WEATHER COMMUNICATIONS SYSTEMS

Weather information is extremely perishable because of its changeable nature. The distributing function is a very large one, including the collection and dissemination of observed data and the delivery of products of the analyses and forecasting centers. Existing methods for collection and distribution of weather information are teletype circuits or terminals and facsimile networks. Updated circuits have incorporated the use of computers and satellite communications. Weather information may also be transmitted by landline, which is a fixed wire circuit from station to station, or from a control station to a group of stations, or by radio. Radio is used to transmit and receive information where the use of landline

is impractical or impossible; i.e., direct pilot to meteorology (METRO) radio and air traffic control pilot to controller circuits.

TELETYPE CIRCUITS

The teletype circuits used for the distribution of aviation weather information are service A, C, O, and Aeronautical Fixed Telecommunications Network (AFTN) which are operated by the FAA and military teletype networks.

SERVICE A.—The primary purpose of this system is collecting and disseminating aviation weather reports and Notice to Airmen (NOTAMs).

SERVICE C.—This system is used primarily for collecting and disseminating domestic synoptic weather information.

SERVICE O.—The service O system is used primarily for collecting and disseminating international weather information.

AFTN.—The AFTN is used primarily for international flight safety and meteorological information.

MILITARY NETWORK.—CONUS, Continental United States, Meteorological Data System (COMEDS) is an Air Force network used to collect military aviation weather observations, pilot reports and NOTAMs in the contiguous U.S., and to provide rapid distribution of this information to military users.

The Navy has established Naval Oceanography Command activities, staffed by Aerographer's Mates (AGs) and Navy Meteorological Officers, which collect weather observations from ships at sea and other Navy weather facilities worldwide. Navy-originated weather reports and forecasts may be entered on the COMEDS circuit, which can be fed into FAA weather circuits, or transmitted via naval communications depending upon the origin, content, and purpose.

FACSIMILE NETWORKS

Facsimile networks are used to distribute analyses and forecasts in graphic form. Special depictions of other types, such as photographs, also can be made through this distribution method. There are four such networks presently in use; two are operated by the National Weather Service and one each by the Navy and Air Force. This method may be considered preferable to the teletype; however, present facsimile networks are incapable of handling the volume of aviation weather required.

LOCAL DISTRIBUTION

Air Traffic Controllers (ACs) are concerned mostly with weather conditions in the immediate vicinity, and within 50 miles, of the airport. Weather forecasts are used regularly for planning purposes, such as selection of the runway, etc.; however, ACs are more concerned with present conditions and those conditions expected within the hour.

Obviously, the amount of weather elements, weather reports, and forecasts discussed in this chapter and Chapter 3 (although necessary for complete weather service) is much more than you need as an AC in the performance of routine tasks. Therefore, Navy AGs prepare all the weather information that aircrews have to know and will supply you with all the meteorological information you will need. This weather information is distributed locally by various methods including TelAutograph (a remote mechanical writing device), interphone, and closed circuit television.

EXERCISE

4-1. What agency or command is responsible for the nation's aviation weather service?

4-2. What agency or command is responsible for providing Naval activities with meteorological information?

4-3. Of the four FAA Weather Teletype Circuits discussed, what/which circuit(s) is/are used primarily to disseminate domestic weather information?

4-4. What is the primary purpose of the COMEDS teletype network?

HOURLY AVIATION WEATHER REPORTS

This section discusses hourly aviation weather reports and gives an explanation of their encoding and decoding. Also listed are examples of the phraseology to be used, which coincides with standard voice procedures for broadcasting these reports. The examples are limited to a brief coverage and are intended to provide you with a working knowledge of aviation weather reports.

CONTENT AND FORMAT OF THE HOURLY AVIATION OBSERVATION REPORT

Learning Objective: **Decode weather data using standard codes and contractions.**

Figure 4-1 is an example of the format used and the coding of an hourly airway surface observation as it would be received on Service A or the COMEDS teletype circuits. The body of the report is composed of the following elements and arranged in the following order:

1. Location identifier (station designator)
2. Type and time of report
3. Sky and ceiling
4. Visibility, weather, and obstructions to vision
5. Sea-level pressure
6. Temperature and dewpoint
7. Wind direction, speed, and character
8. Altimeter setting
9. Remarks

Location Identifier (Station Designator)

PIT SP Ø115 -X M11V BKN 38 OVC 7/8VL-FK 146/66/65/2713/967/R1ØLVR26V55 FK3 CIG 9V12 BKN 27 VSBY 3/4V1

In the United States, a three-letter station designator is used to identify the station sending the report. In some cases these designators suggest the name of the station. The "PIT" in the example above identifies Pittsburgh, Pennsylvania. All location identifiers are found in the FAA Location Identifiers Handbook 7350.1.

Type and Time of Report

PIT SP Ø115 -X M11V BKN 38 OVC 7/8VL-FK 146/66/65/2713/967/R1ØLVR26V55 FK3 CIG 9V12 BKN 27 VSBY 3/4V1

Aviation observation reports are classified as either a record (SA), a special (SP), a record special (RS), or a local (L) observation. The designation is determined by the existing weather conditions or the operational needs at the time of the observation. The time the observation was taken is recorded in Greenwich Mean Time (GMT) and is based on the 24-hour clock. The time group is encoded using four digits. In the example above "SP Ø115" indicates a special observation that was taken at 1:15 a.m. GMT. The following discussion will help you to better understand the different types of reports.

RECORD OBSERVATION (SA).—Record observations are taken at hourly intervals. These are basic observations which supply the weather information for the hourly aviation observation report. The collective SA report, which includes the current hours observation for many stations, normally has a standard time of H+00 (on the hour).

SPECIAL OBSERVATION (SP).—Special weather observations are taken and transmitted as soon as possible after certain significant weather changes have occurred. You will find the conditions that require a special observation listed in the Federal Meteorological Handbook No. 1

PIT SP Ø115 -X M11V BKN 38 OVC 7/8VL-FK 146/66/65/2713/967/ R1ØLVR26V55 FK3 CIG 9V12 BKN 27 VSBY 3/4V1		
PIT	1.	STATION IDENTIFICATION: Identifies report for Pittsburgh.
SP Ø115	2.	TYPE AND TIME OF REPORT: "SA", "RS", or "SP" with time of observation.
-X M11V BKN 38 OVC	3.	SKY AND CEILING: Partially obscured sky, ceiling 1100 ft. variable broken, 3800 ft. overcast.
7/8VL-FK	4.	PREVAILING VISIBILITY: Seven-eighths statute mile variable. WEATHER AND OBSTRUCTION TO VISION: Light drizzle, fog, and smoke.
146	5.	SEA LEVEL PRESSURE: 1014.6 millibars.
66/65	6.	TEMPERATURE: 66°F. DEWPOINT: 65°F.
2713	7.	WIND: 270° true, 13 knots.
967	8.	ALTIMETER: 29.67
R1ØLVR26V55 FK3 CIG 9V12 BKN 27 VSBY 3/4V1	9.	REMARKS: RUNWAY VISUAL RANGE: Runway 1ØL, visual range variable between 2600 and 5500 ft. REMARKS: Fog and smoke hiding 3/10 of the sky. REMARKS: Ceiling variable between 900 and 1200 ft. REMARKS: BASES AND TOPS OF CLOUDS: Tops of broken layer 2700 ft. msl. Note: Height of bases not visible from the station would precede the sky cover symbol. REMARKS: Visibility variable between 3/4 and 1 mile.

Figure 4-1.—Hourly aviation weather report.

(FMH 1). The special observation differs from the record observation (SA), in that the sea-level pressure, temperature, and dewpoint normally are omitted. However, these items are included in single element specials reporting tornadoes, funnel clouds, etc.

RECORD SPECIAL OBSERVATION (RS).—If the time of the significant weather change, which requires a special observation, coincides with the normal record observation time, the two reports are combined. When this happens, the letters RS are included in the SA report to attract attention to the fact that a significant change in weather conditions has occurred since the last reporting period.

LOCAL OBSERVATION (L).—Local observations are taken to support local operational needs and when aircraft mishaps occur. They supplement the hourly aviation observations and are distributed locally only. Normally, a local observation does not contain all the elements of a record observation. However, when an aircraft mishap occurs, all elements except sea-level pressure are included.

Sky and Ceiling

PIT SP Ø115 -X M11V BKN 38 OVC 7/8VL-FK 146/66/65/2713/967/R1ØLVR26V55 FK3 CIG 9V12 BKN 27 VSBY 3/4V1

The purpose of reporting the sky condition is to give the user as much information as possible about the clouds and obscuring phenomena. All layers of clouds and obscuring phenomena visible from the ground up are reported.

SKY COVERAGE.—The amount of sky covered by a layer of clouds is indicated by a contraction. These contractions and their definitions are contained in table 4-1. When at least half of the layer aloft is transparent, the layer is classified as thin. A thin layer is indicated by placing a minus sign (−) before the sky cover contraction; i.e., -BKN for thin broken.

The height of the base of each cloud layer is indicated by a number or numbers in front of a sky cover contraction. This height is reported and encoded in hundreds of feet above ground level (AGL) and rounded off to the nearest reportable value. These reportable values and their encoding are shown in table 4-2. In studying table 4-2, note that the heights of cloud layers are rounded off to the nearest 100 feet up to 5,000 feet, the nearest 500 feet from 5,000 up to 10,000, and to the nearest 1,000 feet above 10,000 feet. For example: A "1" represents a height of 100 feet; "24" a height of 2,400 feet; and "100" a height of 10,000 feet. A height of 5,300 feet would be rounded off to 5,500 feet and encoded as "55", and 10,600 would be rounded off to 11,000 and encoded as "110". All layers are reported in ascending order. That is to say, from the lowest layer to the highest layer.

Past experience has shown that sky conditions reported in terms of scattered, broken, or overcast may not always be appropriate. There are times when the sky may be obscured by surface-based phenomena other than clouds (such as fog, precipitation, dust, smoke, or haze), and to report these as clouds would be misleading. Therefore, the letter "X" is used in the report to indicate that the weather observer cannot see the sky or clouds because of surface-based phenomena. A minus sign used with an X (-X) would indicate a sky that is partially obscured by a surface-based phenomenon.

CEILING.—A ceiling is defined as either of the following:

1. The height assigned to the lowest broken or overcast layer aloft which is predominantly opaque (you can not see through it).

2. The vertical visibility into surface-based phenomena associated with an obscured sky.

Note that a letter precedes the height of a ceiling layer. This letter is called a ceiling designator letter and is used to indicate how the height of the ceiling was obtained. These letters (either an "E" for estimated, "M" for measured, or "W" for indefinite) and their meanings are explained in table 4-3. Thus a ceiling is described by: (1) a ceiling designator letter, (2) a height (AGL), and (3) a sky cover contraction.

Table 4-1.—Sky cover contractions

Summation Amount of Sky Cover in Tenths	Contraction	Remarks
1/10 to less than 10/10 surface-based obscuring phenomena	-X	No height assigned this condition. Vertical visibility is not completely restricted.
10/10 surface-based obscuring phenomena	X	Always preceded by a vertical visibility value.
Less than 1/10	CLR	This contraction is not used in combination with others. If considered significant, include a remark in column 13 pertaining to the presence of less than 1/10 clouds, e.g., STFRA NW.
1/10 thru 5/10 half or more thin	-SCT	Height values preceding these contractions are never designated as ceiling layers.
1/10 thru 5/10 more than half opaque	SCT	
6/10 thru 9/10 half or more thin	-BKN	
6/10 thru 9/10 more than half opaque	BKN	Height value preceding this contraction prefixed with a ceiling layer designator provided a lower ceiling layer is not present.
10/10 half or more thin	-OVC	Height value preceding this contraction is never prefixed with a ceiling layer designator.
10/10 more than half opaque	OVC	This contraction is used in combination with lower overcast layers only when such layers are classified as thin. Height value preceding this contraction is prefixed with a ceiling layer designator provided a lower broken ceiling layer is not present.

Table 4-2.—Sky cover height values

Feet	Reportable values (coded in hundreds of feet)	Encoded
5,000 or less	To nearest 100 ft	1,10,50, etc.
5,001 to 10,000	To nearest 500 ft	55,75,100 etc.
Above 10,000	To nearest 1,000 ft	140,180, 200, etc.

Table 4-3.—Ceiling symbols

Symbol	Meaning
E	Identifies a ceiling height for a layer aloft determined by any other method not specified as "M".
W	Identifies the ceiling height as being the vertical visibility into a surface-based obscuring phenomena.
M	Identifies a ceiling height for a layer aloft determined by a ceiling light, ceilometer, cloud-height detection radar, or based on the known height of objects in contact with the ceiling layer and within 1 1/2 nautical miles of the airport.

A "V" immediately following the height value of a cloud layer indicates a variable ceiling, the height of which is below 3,000 feet. This is a condition in which a ceiling's height rapidly increases and decreases by one or more reportable values while the observation is being taken. The reported height represents an average of all observed heights and the range of the variation is shown in the remarks section. For example: "**M2ØV BKN**" appearing in the body of a report would indicate a broken ceiling that varies in height, the average of which is 2,000 feet. In the remarks section you would find "**CIG 18V22**" meaning that the ceiling height varies between 1,800 and 2,200 feet. You may also find "**BKN V OVC**" or "**BKN V SCT**" in the remarks section. This would indicate a sky condition which was varying while the observation was being taken.

In block 3 of figure 4-1, find the sky and ceiling condition elements and their breakdown. Note the remarks "**CIG 9V12**" in block 9. This tells you that the ceiling height is varying between 900 and 1,200 feet.

SUMMATION TOTAL.—The last point in this discussion on sky and ceiling conditions is that the amount of sky coverage, i.e., broken, scattered, or overcast, is determined by a summation total method. The observer cannot see an entire layer when part of that layer is hidden from view by lower clouds. Thus, a method of summation or addition is used to overcome this problem. In other words, for any given layer aloft, the amount of coverage is determined by adding what you can see, or the unconcealed amounts at that level, to the amount of coverage of all levels below it. For example: A sky with 3/10 coverage at 2,000 feet, plus 3/10 coverage estimated at 5,000 feet, and 4/10 coverage at 10,000 feet would have the following sky cover amount for each layer (refer to table 4-1):

2,000 feet; 3/1Ø or SCT
5,000 feet; 3/1Ø + 3/1Ø = 6/1Ø or BKN
10,000 feet; 3/1Ø + 3/1Ø + 4/1Ø = 1Ø/1Ø or OVC

The complete sky cover report would appear as:

2Ø SCT E5Ø BKN 1ØØ OVC.

Visibility, Weather, and Obstructions to Vision

PIT SP Ø115 -X M11V BKN 38 OVC 7/8VL-FK 146/66/65/2713/967/R1ØLVR26V55 FK3 CIG 9V12 BKN 27 VSBY 3/4V1

VISIBILITY.—Visibility is the greatest distance at which selected objects can be

seen and identified. The objects should be dark or nearly dark when viewed against the horizon sky during the day, or unfocused lights of moderate intensity during the night. Table 4-4 shows the reportable visibility values. Visibility is reported in statute miles (nautical miles onboard ships) and fractions thereof up to 3 miles, the nearest whole mile up to 15 miles, and the nearest 5 miles beyond 15 miles. NOTE: Seven miles is considered unrestricted. Due to horizon limitations, few stations can see beyond this distance.

The prevailing visibility is recorded in the body of the hourly aviation weather report. Prevailing visibility is the greatest distance that you can see throughout at least half of the horizon circle, not necessarily continuous. (See figure 4-2.) If you had uniform weather conditions, determining the visibility would be relatively simple, since it would be the same in all directions. However, in nonuniform weather conditions, the visibility can vary from sector to sector as you look around the horizon.

An aid to use when determining the prevailing visibility is to divide the horizon into several sectors or sections, each of which has substantially the same visibility. This is called sector visibility. In the top example of figure 4-2 the greatest visibility attained throughout at least half of the horizon circle is 3 miles. This is the prevailing visibility that would be entered in the body of the report. The sector or sectors which are different

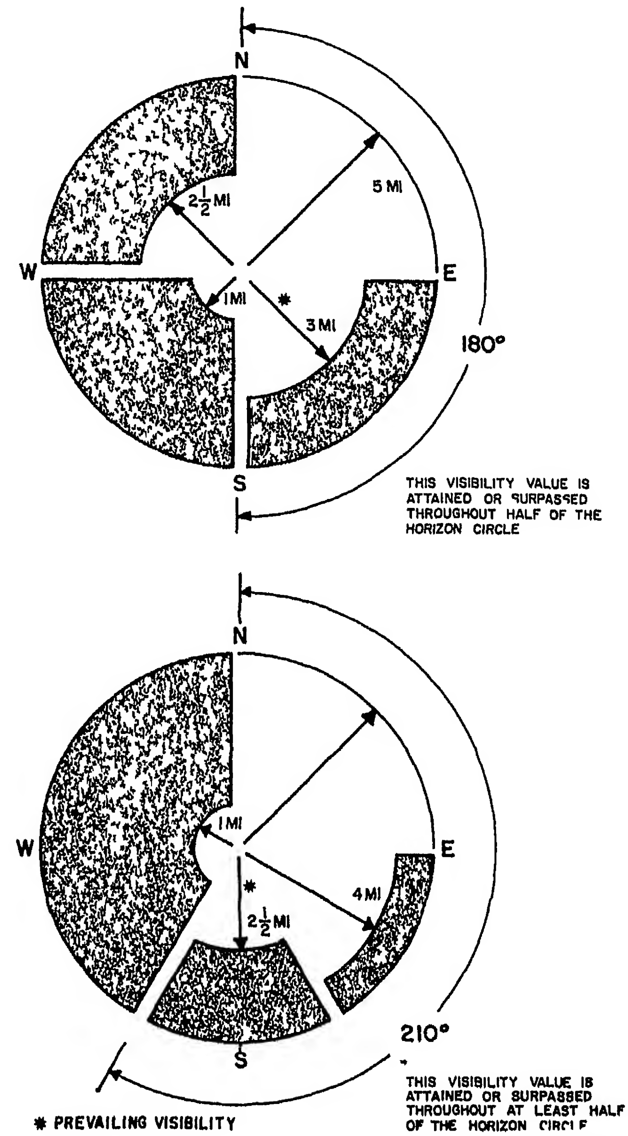

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Figure 4-2.—Prevailing visibility.

Table 4-4.—Reportable visibility values

Increments of separation (Miles)							
1/16	1/8		1/4	1		5
0	3/8	1 1/4	2	3	10	15
1/16	1/2	1 3/8	2 1/4	4	11	20
1/8	5/8	1 1/2	2 1/2	5	12	25
3/16	3/4	1 5/8	2 3/4	6	13	30
1/4	7/8	1 3/4	3	7	14	35
5/16	1	1 7/8		8	15	40
3/8	1 1/8	2		9		etc.

from the prevailing visibility and less than 3 miles, are encoded in the remarks section. (Refer to the southwest and northwest sectors in the top example of figure 4-2.) Therefore, the southwest and northwest sector visibilities in figure 4-2 should be entered in the remarks section because they are less than 3 miles and are different from the prevailing visibility. In this example, the remarks section would show "VSBY SW1NW2 1/2".

Should the prevailing visibility be less than 3 miles and vary by one or more reportable values as

the observation is being made, the letter "V" is added to the visibility value in the body of the report, and the range of the variation entered in remarks. An example would be: "3/4V" appears in the body of the report. The remarks section would show "**VSBY 1/2V1**".

In the SA example at the beginning of this section, the prevailing visibility is reported to be "7/8V" or seven-eighths of a mile and variable. The remarks section shows that the visibility varies between 3/4 and 1 mile.

Should you be assigned to a control tower, you may be required to take visibility observations when the visibility is 4 miles or less. The Commander, Naval Oceanography Command administers an examination to certify Navy control tower personnel as visibility observers. In any event, you should always make limited observations and forward them to the official observer for verification when you notice any differences between the reported weather and what you observe. In the Navy we encode surface visibility in the body of the report. However, should you report tower visibility which you consider to be significant or will affect the safe operation of aircraft, it is included in the remarks section of the report.

WEATHER ELEMENTS.—Weather, as we use it here, refers to those items listed in table 4-5, rather than to the more general meaning of all atmospheric phenomena. Weather is always reported when observed, regardless of how much it restricts visibility. The intensity of precipitation (how much or how hard it rains, snows, etc.), with the exception of hail (A) or ice crystals (IC), is shown by placing a plus sign (+) after the weather symbol for heavy precipitation, or a minus sign (−) for light precipitation. If the intensity symbol is not there it indicates moderate precipitation. The maximum diameter of hail stones is reported in the remarks section.

As you can see in table 4-5, TORNADOES, WATERSPOUTS, AND FUNNEL CLOUDS are always spelled out in full. They are followed by letters representing the points of the compass showing the direction they are bearing from the station and the direction toward which they are moving. An example would be: "TORNADO NW MOVG E" or a tornado has been spotted to the northwest and is moving eastward. Still referring to table 4-5, you can see that precipitation is divided into three classes: (1) liquid, (2) freezing, and (3) frozen. If two different classes of precipitation are present, i.e., rain and freezing rain, they are encoded in the order listed above—liquid, freezing, or frozen. If more than one type of precipitation of the same class is present, i.e., snow and snow pellets, the one with the greatest intensity is encoded first. For example: Heavy snow and moderate snow pellets is encoded "S+SP".

OBSTRUCTIONS TO VISION.—Hydrometeors (water based) and lithometeors (solid based) are particles of matter suspended in the atmosphere or lifted aloft by the wind. These particles are encoded using letter symbols (see table 4-5) and are reported if they restrict the visibility to 6 miles or less. If there is more than one type of obstruction to vision present, the order of encoding is in the order of decreasing predominance, or the most restrictive first followed by the next, and so on to the least restrictive. Refer to the underlined part in our example at the beginning of this section. The obstructions to vision are fog and smoke. We can assume in this case that the fog is restricting the visibility more than the smoke.

Sea Level Pressure

PIT SP Ø115 -X M11V BKN 38 OVC 7/8VL-FK 146/66/65/2713/967/R1ØLVR26V55 FK3 CIG 9V12 BKN 27 VSBY 3/4V1

Sea level pressure is the reporting station's barometric pressure, reduced to sea level, and is measured in millibars. It is encoded in three figures representing tens, units, and tenths of millibars. The first one or two digits of the sea level pressure and the decimal point are omitted. For example: 1025.1 millibars is encoded as "251", and 999.0 millibars is encoded as "99Ø". The sea level pressure is mainly used by the meteorologists and is NOT broadcast to pilots when weather reports are transmitted. However, pilots do sometimes ask for this information so that they can compute their takeoff distance requirements or actual altitude. If you receive a request for the pressure in millibars, DO NOT use the pressure shown in the hourly report, but

Table 4-5.—Symbols for weather and obstruction to vision

WEATHER

TORNADO	always
WATERSPOUT	written out
FUNNEL CLOUD	in full

		Freezing Rain	ZR
		Freezing Drizzle	ZL
		Ice Pellets	IP
		Ice Pellet Showers	IPW
Severe Thunderstorm	T+	Snow	S
Thunderstorm	T	Snow Showers	SW
Rain	R	Snow Pellets	SP
Rain Showers	RW	Snow Grains	SG
Drizzle	L	Ice Crystals	IC
		Hail	A

PRECIPITATION INTENSITY SYMBOLS

+	Heavy	Absence of symbol indicates moderate
-	Light	

No intensity is assigned to hail or ice crystals.

OBSTRUCTION TO VISION

HYDROMETEORS		LITHOMETEORS	
F	Fog	BN	Blowing Sand
GF	Ground Fog	H	Haze
BS	Blowing Snow	K	Smoke
BY	Blowing Spray	D	Dust
IF	Ice Fog	BD	Blowing Dust

1. Combinations of these symbols are entered in the following order:

   a. TORNADO, FUNNEL CLOUD, or WATERSPOUT
   b. Thunderstorm
   c. Liquid precipitation, in order of decreasing intensity
   d. Freezing precipitation, in order of decreasing intensity
   e. Frozen precipitation, in order of decreasing intensity
   f. Obstructions to vision, in order of decreasing predominance, if discernible

2. Obstructions to vision are reported only when the prevailing visibility is less than 7 miles and the obstruction to vision is occurring at the station. If the visibility is reduced to less than 7 miles by obscuring phenomena not at the station, report the phenomena in Remarks.

forward the request to the weather office for an up-to-date computation to be relayed to the pilot. The "146" reported in the example for sea level pressure is decoded as 1014.6 millibars.

Temperature and Dewpoint

PIT SP Ø115 -X M11V BKN 38 OVC 7/8VL-FK 146/66/65/2713/967/R1ØLVR26V55 FK3 CIG 9V12 BKN 27 VSBY 3/4V1

The temperature and dewpoint are encoded to the nearest whole degree Fahrenheit using one, two, or three digits. If either is below zero, it is preceded with a minus sign (−). The difference between the temperature and dewpoint indicates the amount of water vapor in the air. When there is a small spread between the temperature and dewpoint, usually three degrees or less, there is a strong probability of fog formation. Referring to our example above, the temperature and dewpoint are decoded as: 66 and 65 degrees Fahrenheit respectively.

Wind

PIT SP Ø115 -X M11V BKN 38 OVC 7/8VL-FK 146/66/65/2713/967/R1ØLVR26V55 FK3 CIG 9V12 BKN 27 VSBY 3/4V1

Wind information is normally encoded in a four digit group representing the direction and speed of the wind. The wind character, such as gust or squall, is reported as the wind changes require. If either wind direction or speed is estimated, the letter "E" precedes the wind group.

DIRECTION.—The direction FROM which the wind is blowing determines the wind direction reported. A north wind means that the wind is blowing from true north. Wind direction is reported to the nearest 10 degrees starting at true north (360 degrees) and moving clockwise from east to west. When encoding the wind direction, only the first two digits are used; i.e., "Ø1" represents 010 degrees; "1Ø", 100 degrees; "28", 280 degrees, etc. A calm or no wind direction is reported as double zero "ØØ".

SPEED.—The wind speed is given in knots. The speed reported is actually the average speed for a period of time, usually one minute. If the wind is calm, the speed, like the direction, is encoded using two zeros. The wind group for a calm wind would be encoded as "ØØØØ". Wind in excess of 99 knots is encoded by adding 50 to the direction and encoding the tens and units of the speed. For example: A wind from 360 degrees at 105 knots would be encoded as "86Ø5".

CHARACTER.—The character of the wind refers to the rise and fall or variability of speed in gusts or squalls.

1. A gust is defined as a change in speed of 10 knots or more between peak and lull occurring over brief periods of time. Gusts are encoded by suffixing the letter "G" to the average speed followed by the peak speed in the gusts. For example: If the wind is from 270 degrees and varying or gusting from 12 to 26 knots, the average speed is 19 knots. This wind group would appear "2719G26".
2. A squall is defined as a sudden increase in wind speed by 15 knots or more, to a peak of at least 20 knots, and lasting for a minimum of one minute. Squalls are encoded by suffixing the letter "Q" to the average speed followed by the peak speed in the squalls. For example: An average wind speed of 20 knots from 270 degrees, with peak gusts in squalls up to 35 knots, would be encoded as "272ØQ35".

The underlined wind group in our example "2713", indicates an average wind from 270 degrees at 13 knots.

Altimeter

PIT SP Ø115 -X M11V BKN 38 OVC 7/8VL-FK 146/66/65/2713/967/R1ØLVR26V55 FK3 CIG 9V12 BKN 27 VSBY 3/4V1

The altimeter setting is a pressure measurement in inches of mercury (Hg) reported to the nearest hundredth of an inch. In order to save teletypewriter space and time, only the last three digits of the altimeter are encoded and the decimal point is omitted. An altimeter setting of 29.92 Hg would be endoced as 992.

The normal sea level pressure ranges from 28.00 to 31.00 Hg. When decoding the altimeter, you add a 2 or a 3 to the coded group to bring the altimeter as close as possible to 30.00 Hg. In other words, to decode the altimeter, if the first number of the coded group is a zero, prefix a three (3) and point off two decimal places to the left. If the first number is NOT a zero, prefix a two (2) and point off two decimal places to the left.

Therefore, 002 is decoded as 30.00 and 898 is decoded as 28.98.

Remarks

PIT SP Ø115 -X M11V BKN 38 OVC 7/8VL-FK 146/66/65/2713/967/R1ØLVR26V55 FK3 CIG 9V12 BKN 27 VSBY 3/4V1

The remarks section provides additional information which may be of use to a pilot, an air traffic control specialist, or a meteorologist. The remarks include weather information not covered in the body of the report and other information which may contribute to the items listed in the main body of the sequence report. Here are some examples of items that might appear in the remarks section.

1. Obscuring Phenomena:

CODED	MEANING
D5	Dust obscuring 5/10 of the sky
K2Ø SCT	Scattered smoke aloft based at 2000 feet
THIN FOG NW	Thin fog northwest

2. Wind Shifts:

WSHFT 3Ø	Wind shifted at 30 minutes past the hour

3. Heights of Bases and Tops of Sky Cover Layers: The heights of the bottom of clouds or bases, and of cloud layers not visible at the reporting station may be reported. This information is supplied by pilots who have been in the area. The reported heights listed in the examples are above MSL.

BKN 5Ø	Top of broken layer 5000 feet MSL
OVC 3Ø/6Ø OVC	Top of lower overcast 3000 feet MSL, base of higher overcast 6000 feet MSL

4. Sky and Ceiling:

CODED	MEANING
FEW CU	Few cumulus clouds
HIR CLDS VSB	Higher clouds visible
BINOVC	Breaks in overcast
BRKS N	Breaks north
CIG 14V19	Ceiling variable between 1400 feet and 1900 feet
F3	3/10 sky obscured by fog
3Ø SCT V BKN	Layer at 3000 feet scattered variable to broken
TCU W	Towering cumulus clouds west
CB ALL QUADS	Cumulonimbus all quadrants
CONTRAILS N 42Ø MSL	Condensation trails north at 42,000 feet MSL
CLDS TPG MTNS SW	Clouds topping mountains south-west
LWR CLDS NE	Lower clouds northeast

5. Visibility:

VSBY S1W1/4	Visibility south 1, west 1/4
VSBY 1V3	Visibility variable between 1 and 3
TWR VSBY 3/4	Tower visibility 3/4

6. Weather and Obstructions to Vision:

UNCONFIRMED TORNADO 15 W OKC MOVG NE 2ØØØ	Unconfirmed tornado 15 nautical miles west of Oklahoma City, moving northeast sighted at 2000 GMT
TB13 OVHD MOVG E	Thunderstorm overhead, moving east, began 13 minutes after the hour
OCNL DSNT LTG NW	Occasional distant lightning northwest
AB35E55 HLSTO 2	Hail began 35 ended 55, hailstones 2 inches in diameter
SNOINCR 5	Snow increased 5 inches during past hour
R– OCNLY R+	Light rain occasionally heavy rain
F DSIPTG	Fog dissipating
KOCTY	Smoke over city
DUST DEVILS NW	Dust devils northwest
PATCHY GF S	Patchy ground fog south

7. Pressure:

CODED	MEANING
PRESRR	Pressure rising rapidly
PRESFR	Pressure falling rapidly
PRES UNSTDY	Pressure unsteady

8. Runway Surface Condition: When this information is included in the report, such as a wet runway or snow on the runway, then the runway condition reading (RCR) is also reported. RCR is a decelerometer reading which is determined by driving a specially equipped vehicle on the runway to obtain the equivalent runway braking action. The decelerometer reading is a two-digit number between 02 and 25 and is entered in the report following the surface condition.

a. Surface Condition:

WR	Wet runway
SLR	Slush on runway
LSR	Loose snow on runway
PSR	Packed snow on runway
IR	Ice on runway
P	Patchy conditions
SANDED	Runway sanded

b. Runway condition Readings:

RCR	Equivalent breaking action	% increase in landing roll
02-05	NIL	100% or more
06-12	POOR	99% or more
13-18	FAIR (medium)	45% to 16%
19-25	GOOD	15% to 0

Examples:

PSR15	Packed snow on runway; decelerometer reading 15
IR05P/SANDED	Ice on runway; decelerometer reading 05; condition patchy; runway sanded

9. Pilot Reports (PIREPs): Pilots will normally report the height of the bases and tops of clouds that they come across during their flight. This information can be included in the remarks if: (1) the cloud layer is not visible from the reporting station; (2) the cloud layer is within 20 miles of the reporting station (50 miles for cirriform clouds) and; (3) the pilot report is received within 15 minutes of the normal observation time. The figures preceding the sky cover contraction indicate the height MSL of the bases, and the figures following the sky cover contraction indicate the height MSL of the tops. For example:

36 BKN 66	Broken layer, bases 3600 feet, tops 6600 feet

We will get into PIREPs later in this chapter.

EXERCISE

4-5. In the spaces provided below, identify each lettered element of the following hourly weather sequence report.

NAS	SP	0635	M5 OVC	1 1/2R	137/	67/63/	1608/	990/	OVC 70
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)

a. ____________ b. ____________
c. ____________ d. ____________
e. ____________ f. ____________
g. ____________ h. ____________
i. ____________ j. ____________

Encode or decode, as appropriate, each of the following weather sequence items using proper codes and contractions.

4-6. Encode: A special observation taken at NAS Norfolk, Va. (NGU), at 1634Z, with a measured ceiling at 500 feet, covering 7/10 of the sky.

4-7. Using summation totals, encode: Cloud layers at two thousand (3/10 sky cover), estimated three thousand (3/10 sky cover), and two eight thousand (3/10 sky cover).

4-8. Encode: Visibility varying between 1/2 and 1 mile, fog, moderate snow, some blowing snow, and light rain.

4-9. Encode: Wind from 270 degrees true at 7 knots.

4-10. Decode: Wind encoded as 6110.

4-11. Decode: WØXØF.

4-12. Decode: 1Ø SCT E3Ø OVC 5H 141/38/28/E3215/ØØØ.

4-13. Decode: R18RVV1/4+

PHRASEOLOGY FOR WEATHER REPORT ITEMS

Learning Objective: **State the proper broadcasting procedures and phraseology used to transmit weather information to pilots.**

ACs are continuously required to transmit weather information to pilots via radio. The following list includes some examples of the phraseology and standard FAA voice procedures you must use when broadcasting these weather reports.

1. State the height and character of sky coverage data as follows:

a. In the same order of ascending height in which they appear in the weather report.

b. Do not say the word "clouds."

c. Announce ceiling designators as follows:

CODED	SPOKEN
E	ESTIMATED CEILING
M	MEASURED CEILING
W	INDEFINITE CEILING

d. State heights in hundreds and/or thousands of feet.

9	NINER HUNDRED
18	ONE THOUSAND EIGHT HUNDRED
2ØØ	TWO ZERO THOUSAND

e. Announce sky cover symbols as follows:

CLR	CLEAR
SCT	SCATTERED
BKN	BROKEN
OVC	OVERCAST

f. When a dask precedes a cloud symbol, say the word THIN.

7-BKN	SEVEN HUNDRED THIN BROKEN

g. Announce a ceiling height indicated by the figure "Ø" as ZERO.

h. Announce a condition indicated by "X" or "−X" as:

X	SKY OBSCURED
−X	SKY PARTIALLY OBSCURED

i. Announce sky and ceiling conditions (not all possible combinations of phenomena are included) in accordance with the following:

-X M1Ø BKN 5Ø BKN	SKY PARTIALLY OBSCURED MEASURED CEILING ONE THOUSAND BROKEN, FIVE THOUSAND BROKEN.
2Ø SCT E3Ø BKN 25Ø BKN	TWO THOUSAND SCATTERED, ESTIMATED CEILING THREE THOUSAND BROKEN, TWO FIVE THOUSAND BROKEN.
M1Ø BKN 5Ø BKN 3ØØ OVC	MEASURED CEILING ONE THOUSAND BROKEN, FIVE THOUSAND BROKEN, THREE ZERO THOUSAND OVERCAST.
1Ø SCT 5Ø SCT	ONE THOUSAND SCATTERED, FIVE THOUSAND SCATTERED.
-X M5 OVC	SKY PARTIALLY OBSCURED, MEASURED CEILING FIVE HUNDRED OVERCAST
-X 5 -BKN 1Ø -BKN 5Ø-OVC	SKY PARTIALLY OBSCURED, FIVE HUNDRED THIN BROKEN, ONE THOUSAND THIN BROKEN, FIVE THOUSAND THIN OVERCAST
10 -SCT E 2Ø BKN	ONE THOUSAND THIN SCATTERED, ESTIMATED CEILING TWO THOUSAND BROKEN

2. Announce prevailing visibility immediately following sky conditions in accordance with the following examples:

1/16	VISIBILITY ONE-SIXTEENTH
1/8	VISIBILITY ONE-EIGHTH
3/4	VISIBILITY THREE-QUARTERS
1 1/2V	VISIBILITY ONE AND ONE-HALF VARIABLE
6	VISIBILITY SIX

3. If atmospheric phenomena and obstructions to vision appear in a weather report, announce them following the prevailing visibility, as follows:

a. Atmospheric phenomena:

T	THUNDERSTORM
R	RAIN
RW	RAIN SHOWERS
ZR	FREEZING RAIN
L	DRIZZLE
ZL	FREEZING DRIZZLE
IP	ICE PELLETS
S	SNOW
SW	SNOW SHOWERS
SP	SNOW PELLETS
SG	SNOW GRAINS
IC	ICE CRYSTALS
A	HAIL

b. Announce as HEAVY or LIGHT when a plus sign (+) or a dash (-), respectively, is suffixed to the precipitation symbol. Announce "T" as THUNDERSTORM AND "T+" as SEVERE THUNDERSTORM. No suffix is attached to hail or ice crystals regardless of the intensity.

c. Obstructions to vision:

F	FOG
GF	GROUND FOG
IF	ICE FOG
BD	BLOWING DUST
BN	BLOWING SAND
BS	BLOWING SNOW
BY	BLOWING SPRAY
H	HAZE
K	SMOKE
D	DUST

4. Omit sea-level pressure from the broadcast; give sea-level pressure in millibars only in response to a specific request from a pilot.

5. Announce temperature and dewpoint in accordance with the following:

a. In one, two, or three figures in Fahrenheit.

b. Below zero degree Fahrenheit values, by prefixing the temperature with the word MINUS.

37/36	TEMPERATURE THREE SEVEN, DEWPOINT THREE SIX
104/99	TEMPERATURE ONE ZERO FOUR, DEWPOINT NINER NINER
-2/-3	TEMPERATURE MINUS TWO, DEWPOINT MINUS THREE

6. Announce current local wind direction and speed as determined from the instruments in the controller's console as follows:

a. State wind direction in tens of degrees (in terms of the magnetic compass), using three digits.

b. Omit the words DEGREES, MAGNETIC, TRUE, and KNOTS.

c. Announce a north wind as WIND THREE SIX ZERO.

d. Announce wind speed in knots. If it is estimated, state the word ESTIMATED. For example ESTIMATED WIND TWO FOUR FIVE AT ONE ZERO.

ØØØØ	WIND CALM
3514	WIND THREE FIVE ZERO AT ONE FOUR
2814G19	WIND TWO EIGHT ZERO AT ONE FOUR PEAK GUST ONE NINER

7. Announce all four digits of the altimeter setting, omitting the decimal point. Use values obtained from altimeter setting indicator instruments, where available.

996	ALTIMETER TWO NINER NINER SIX
Ø1Ø	ALTIMETER THREE ZERO ONE ZERO

8. Announce RVV and RVR as follows:

a. State runway visibility (RVV) in the same manner as prevailing visibility.

RØ4VV1/4V1	RUNWAY FOUR VISIBILITY VARIABLE BETWEEN ONE QUARTER AND ONE
R36VV1 1/2+	RUNWAY THREE SIX VISIBILITY MORE THAN ONE AND ONE-HALF
RVVNO	RUNWAY VISIBILITY NOT AVAILABLE

b. Announce runway visual range (RVR), only for runways with RVR equipment installed and, in hundreds or thousands of feet. When the readout reports 1Ø-, announce as LESS THAN ONE THOUSAND FEET.

R18VR4Ø	RUNWAY ONE EIGHT VISUAL RANGE FOUR THOUSAND FEET
R16VR1Ø-	RUNWAY ONE SIX VISUAL RANGE LESS THAN ONE THOUSAND FEET
RVRNO	RUNWAY VISUAL RANGE NOT AVAILABLE

9. Announce remarks and NOTAMs included in weather reports when of interest to pilots. Do not include additional information intended primarily for the preparation of forecast maps. Announce as follows:

VSBY 1V2	VISIBILITY VARIABLE BETWEEN ONE AND TWO

VSBY NE3 SE2 1/2 SW2	VISIBILITY NORTHEAST THREE, SOUTHEAST TWO AND ONE-HALF, SOUTH-WEST TWO
PTCHS GF W N E	PATCHES OF GROUND FOG WEST, NORTH, AND EAST
TWR VSBY 5 22Ø BKN 28Ø FEW AC OVR RDG SW	TOWER VISIBILITY FIVE, BROKEN CLOUDS RE-PORTED AT TWO TWO THOUSAND, TOPS AT TWO EIGHT THOUSAND, FEW ALTOCUMULUS OVER RIDGE SOUTHWEST
SCT V BKN	SCATTERED LAYER VARIABLE BROKEN
TCU NW	TOWERING CUMULUS NORTHWEST
K1Ø	SMOKE LAYER ONE THOUSAND
RWUE	RAIN SHOWERS OF UN-KNOWN INTENSITY EAST
SNOINCR5	SNOW INCREASED FIVE INCHES DURING PAST HOUR
S- OCNLY S+	LIGHT SNOW, OCCA-SIONALLY HEAVY

EXERCISE

Write the proper phraseology to be used to transmit the following weather sequence reports:

4-14. CLR 3GFH 125/4Ø/38/27Ø4/99Ø

4-15. W1X 1/16F 141/43/43/ØØØØ/ØØØ

4-16. -X E7 OVC 3/8SBS 1Ø5/29/25/3215G2Ø/983

4-17. M5 BKN 15 OVC 2T+RW+ 1Ø5/45/43/3448G55/984

4-18. 15Ø SCT 1Ø 145/89/81/Ø11Ø/ØØ3

PILOT REPORTs (PIREPs)

Learning Objective: **Assemble and encode Pilot Reports using standard codes and authorized contractions.**

As we said before, pilot reports of weather conditions or meteorological phenomena encountered in flight are called PIREPs. When forecasting flight conditions and/or briefing pilots, PIREPs become a valuable source of weather information which often would not be available otherwise. Reports concerning cloud tops, wind, icing levels, etc., are extremely valuable to weather service personnel and pilots when they are planning and executing their flights. Data received from a pilot is placed in standard format for teletype and local video presentation. As an air traffic controller, you will be expected to cooperate to the fullest extent possible in obtaining and relaying PIREPs. In order for you to do this, it is necessary for you to learn what information goes into PIREPs and how they are encoded.

SOLICITING PIREPs

FAA Air Traffic Control Facilities (ATC), Flight Service Stations (FSS), Weather Service Offices (WSO), or another military air station may request that you collect information to be included in PIREPs. You are required to solicit PIREPs when one or more of the following conditions exists or is forecast for your area:

1. Ceilings at or below 5000 feet
2. Visibility (surface or aloft) at or less than 5 miles
3. Thunderstorms and related phenomena

4. Turbulence—especially clear air turbulence (CAT) of moderate degree or greater

5. Icing of moderate degree or greater

6. Low level wind shear

You should relay weather information that you receive from pilots to other aircraft and concerned ATC, FSS, and WSO facilities as soon as possible. Significant PIREPs should be issued on initial contact to aircraft entering your area when such information may affect their route of flight. Pilot reports of tornadoes, funnel clouds, waterspouts, severe or extreme turbulence or clear air turbulence (CAT), hail, severe icing, and wind shears are classified as SEVERE PIREPs, and must be relayed immediately to all pilots and other control facilities within your local area.

PIREP FORMAT

PIREPs, like hourly aviation observations, are encoded in a standard format using authorized contractions and location identifiers. Where contractions are not applicable, use plain language. Each section or element of a pilot report is identified by a Text Element Identifier (TEI). These TEIs are two-letter contractions and, with the exception of the message type, are preceded by a solidus (/). All PIREPs will contain a message type, the location of the phenomena with the time and aircraft's flight level, the type of aircraft, and at least one weather element. The following is a list and brief description of the sections and elements that make up a PIREP:

1. Message type (UA or UUA). The TEI "UA" indicates a routine or regular PIREP follows, whereas "UUA" indicates a severe PIREP follows.

2. Location (/OV), time, and flight level (FL). A three-letter NAVAID location identifier is used to report the location of the phenomena. The magnetic direction in degrees from a NAVAID is indicated by three digits followed by another three digits indicating the distance in nautical miles. For example, if a pilot reported 20 miles south of Washington (DCA), the location would be coded a **/OV DCA 18ØØ2Ø.** A location reported over Washington or between Washington and Richmond (RIC), would be encoded as **/OV DCA** and **/OV DCA-RIC**, respectively. The time used is Greenwich Mean Time (GMT) encoded in hours and minutes as reported by the pilot. The aircraft's flight level or altitude follows the letters FL and is encoded with three digits representing hundreds of feet MSL. For example: **FLØ4Ø** indicates an altitude of 4,000 feet, and **FL19Ø** indicates an altitude of 19,000 feet. If the altitude is unknown, the contraction UNK follows the letters FL.

3. Type Aircraft (/TP). This is another TEI that will always be entered in a PIREP. If the type aircraft is unknown, the entry would be /TP UNK.

4. Sky-Cloud bases and tops (/SK). The heights of the bases and tops of clouds are encoded in hundreds of feet MSL using three digits. The sky cover contractions used are the same as you learned earlier. Example: A broken layer with bases at 9500 feet and tops at 11,000 feet would be encoded as **/SK Ø95 BKN 11Ø.**

5. Air Temperature (/TA). When this TEI is reported, the temperature (in degrees Celsius) is encoded using two digits and a minus sign (−), if applicable.

Example: A temperature of −3 °C is encoded as **/TA -Ø3.**

6. Wind direction and speed (/WV). Wind direction and speed are each encoded using three digits. Example: A wind of 070 degrees at 50 knots is encoded as **/WV Ø7ØØ5Ø.**

7. Turbulence (/TB). When turbulence is reported, the intensity will be encoded first followed by the type and altitude if it is different from that reported with (FL). The reportable intensities and their contractions are:

Light	LGT
Moderate	MDT
Severe	SVR
Extreme	EXTRM

When the type of turbulence is reported, it will be either CAT for high level clear air turbulence or CHOP for choppy, rapid, and somewhat rhythmic bumpiness. Example: Light to moderate chop between 16,000 feet and 19,000 feet would be encoded **/TB LGT-MOD CHOP 16Ø-19Ø.**

8. Icing (IC). The same format used to encode turbulence is used to encode icing. The intensity is encoded first followed by the type and if the altitude involved is different from that shown in "FL", the altitude is included. An additional intensity term (TRACE) may be used when reporting icing conditions. The types of icing, i.e., RIME, CLEAR, AND MIXED, were covered in an earlier chapter. Example: Severe clear icing at 31,000 feet would be encoded **/IC SVR CLR 31Ø.**

9. Remarks (/RM). The data following this TEI is considered to be significant but does not fit in any of the TEIs previously discussed. Some phenomena reported with this TEI would be tornadoes, thunderstorms, hail, electrical discharge (DISCHARGE), condensation trails (CONTRAILS), etc.

EXAMPLES OF PIREPs

1. At 1900 e.s.t (0000 GMT), a C131 6 miles southeast of Jacksonville, at 7,000 feet, reported an overcast layer with bases at 4,500 feet, the tops unknown.

UA /OV JAX 135ØØ6 ØØØØ FL Ø7Ø /TP C131 /SK Ø45 OVC UNK

2. A pilot 35 miles north of Chanute AFB reported a tornado moving northeast, at 2314 GMT. The funnel was observed to be making intermittent contact with the ground.

UUA /OV RAN 36ØØ35 2314 FL UNK /TP UNK /RM TORNADO MOVG NE INTMT CTC W GND

3. A DC3 at 10,000 feet reported light turbulence being encountered at 1406 e.s.t (1906 GMT), over Norfolk.

UA /OV ORF 19Ø6 FL 1ØØ /TP DC3 /TB LGT.

4. A P3 between Norfolk and Richmond, in the clouds at 16,000, reported an electrical discharge 20 miles north of Norfolk at 2349 GMT.

UA /OV ORF 36ØØ2Ø 2349 FL 16Ø /TP P3 /SK OVC /RM DISCHARGE.

EXERCISE

4-19. State the six existing or forecasted weather conditions during which you should solicit PIREPs.

Assemble and encode the following Pilot Reports. You will have to use the contractions and weather codes you previously learned.

4-20. At 1628 c.s.t (2228 GMT), the pilot of a T39 reported hail and light turbulence at 13,000 feet, 15 miles east of NAS Pensacola (NAS).

4-21. At 1100 e.s.t (1600 GMT), the pilot of a C130 reported an electrical discharge over Jacksonville (JAX), to the Flight Service Station.

4-22. At 1815 GMT, a pilot reported 20 miles west of Washington, D.C. (DCA), experiencing wind 160 degrees at 80 knots, at 9,000 feet.

WEATHER FORECASTS AND ADVISORIES

Learning Objective: **Identify the scope of weather forecasts and advisories, and describe the broadcast procedures for meteorological information.**

Airfield operators, pilots, and air traffic control personnel cannot plan flight operations or workloads on existing weather conditions only;

they must also rely on expected weather conditions (forecasts).

FAA and Navy directives require all air traffic control and flight clearance personnel to be briefed on current and forecast weather conditions prior to assuming position responsibility. To assist you in meeting this requirement, a general knowledge of the scope and content of the tools used by the Aerographer's Mate is helpful. Explanations as to the specific content of these products should be directed to your weather service personnel.

FORECASTS

The National Weather Service maintains a comprehensive surface and upper air weather forecasting and pilot briefing service. National Weather Service Forecasters (WSFOs) prepare several types of forecasts; i.e., Terminal (FT), Area (FA), and Winds and Temperatures Aloft (FD) forecast. However, we limit our coverage to their FT and FA forecasts.

The Naval Oceanography Command and its activities use the above forecasts and weather information from other sources to prepare Plain Language Terminal Forecasts (PLATF) or Aerodrome Forecasts (TAF). The PLATF code is currently used by Naval Oceanography Command activities within CONUS, Hawaii, and Alaska. In countries using metric measurements, the TAF code is used.

Terminal Forecasts (FT)

Terminal forecasts are issued by National Weather Service Forecasters (WSFOs) for specific locations three times a day and are valid for 24 hours. The first 18 hours of the FT are an indepth forecast. The last 6-hour period is a general forecast of flight conditions called a categorical outlook. Basically, these forecasts are encoded and contain the same items as the SA report discussed previously. However, some items included in an FT, such as visibility and wind, must meet certain criteria to be included. Visibility is omitted if it is expected to be more than 6 miles; wind is not included if it is expected to be less than 10 knots. The ceiling is identified by the letter (C).

As stated in the preceding paragraph, the last 6 hours of the FT are a categorical outlook. These categories and their meanings are:

CATEGORIES	MEANINGS
LIFR	Ceiling less than 500 and/or visibility less than 1
IFR	Ceiling less than 1000 and/or visibility less than 3
MVFR	Ceiling 1000-3000 and/or visibility 3-5
VFR	Ceiling greater than 3000 and visibility greater than 5

The cause of **LIFR**, **IFR**, and **MVFR** conditions is stated in the outlook. If the category is due only to ceiling, this is shown by the contraction **CIG**. If the category is due only to visibility, standard weather and obstructions to vision symbols are used. If the cause of the category is due to ceiling and visibility, both the contraction **CIG** and standard obstruction to vision symbols are used. If the wind speed, including gust, is expected to be 25 knots or more, the word WIND will appear in the outlook.

Area Forecasts (FA)

Area forecasts describe cloud, weather, and icing conditions anticipated within a prescribed geographical area for an 18-hour period with an additional 12-hour categorical outlook. In these forecasts, cloud heights are reported above mean sea level (MSL) unless otherwise indicated. The height of a ceiling layer, which is always reported above the ground (AGL), is preceded by the contraction CIG. The heights of cloud tops are given for cloud layers with bases of 20,000 feet MSL or lower. As in FTs, visibility is only included in FAs when it is forecast to be 6 miles or less. Surface winds are included when they are expected to maintain speeds of 25 knots or more. In the icing section, a statement of expected icing conditions and the height of the freezing level are included. All FAs start with a synopsis, which is a brief summary describing the locations and movements of significant fronts, pressure systems, and circulation patterns.

Plain Language Terminal Forecasts (PLATF)

The Plain Language Terminal Forecast (PLATF) code has been adopted for use by Naval Oceanography Command and Marine Corps activities transmitting weather data over COMEDS type terminals. The coded PLATF generally employs the same format and abbreviations used in FTs and SAs. Because of the similarity of the PLATF and an aviation observation (SA), with which pilots are familiar, the PLATF can be used as a ready tool by AGs in pilot briefings. The PLATF is also similar to the National Weather Service's FT forecasts which are used extensively for pilot briefing in CONUS.

PLATFs are filed at 6-hour intervals (0300, 0900, 1500, and 2100) and have a valid period of 24 hours. They may be amended (AMD), corrected (COR), or their transmission may be delayed (RTD). The form and content of the code have been designed to include the necessary information for the safe operation and flight planning of aircraft landing and taking off at an air base.

Example: **PLATF Ø9Ø9 8 BKN 5Ø OVC 3R-F 181Ø QNH 3Ø.Ø2**

This PLATF covers a 24-hour period from 0900Z to 0900Z. The forecast is for a predominant ceiling of 800 feet broken with an overcast layer at 5,000 feet. The visibility is forecast to be 3 miles with light rain and fog. There should be a southerly wind (180°) at ten knots, and the lowest forecast altimeter setting (QNH) for the entire period is 30.02 Hg.

NOTE: The station location identifier is inserted automatically by the equipment entering the PLATF into the COMEDS terminal.

Meteorological conditions considered to be of importance and not adequately covered in the general forecast are carried in the remarks section using authorized contractions. Each forecasted change to the general PLATF is preceded by the time the change in weather condition is expected to occur. In addition, each forecasted change will contain the lowest forecasted altimeter setting for that period. The following terms may apply in defining changeable weather conditions:

1. Occasional (OCNL). This term is used to modify a general condition with temporary changes occuring no more than once or twice during the forecasts period to which the general condition applies and lasting considerably less than one-half the total time.
2. Temporary (TEMP). The term TEMP is used to modify the general forecast condition when changes are expected to occur more than once during the forecast period with each instance lasting for less than one hour, and not occurring for more than half of the forecasts period.
3. Vicinity (VCNTY). This term refers to air mass type weather, such as showers, thunderstorms, and patches of ground fog, which are expected to be widely scattered in the general vicinity of the station, and it is expected that there is only a slight chance that they will affect the station itself. The lowest ceiling and visibility expected in the phenomena in the vicinity will be included in the forecast.
4. Gradually (GRADU). This term indicates an improving or deteriorating condition during a specific period.
5. Frontal passages (FROPA). Frontal passages will be included in the forecast only if weather or a condition of operational significance is forecast. It will be indicated by the term FROPA preceded by a four figure time group indicating the expected time of frontal passage and will be followed by an adjusted forecast.

Following is a complete PLATF with explanation:

```
KNGU Ø9Ø9 15 SCT 8Ø BKN 15 181Ø SCT V BKN QNH 3Ø.Ø2
        12Z 15 BKN 8Ø OVC 5H 181Ø 1Ø OVC 2TRW VCNTY
        QNH 3Ø.ØØ
        15Z 15 OVC 3R-F OCNL 8 OVC 1RF QNH 29.99
        17Z 5 OVC 3/4RF 181Ø VSBY 1/2V1 QNH 29.98
        19Z 25 OVC 5R-F 2315 TEMP 15 OVC 3RF QNH 29.98
GRADU 21Z-23Z 15 OVC 1TRW 2315G25 QNH 29.97
        ØØØØZ CLD FROPA 2Ø SCT 8Ø BKN 1Ø 3215G3Ø
        QNH 3Ø.Ø1
        Ø3Z CLR 1Ø 3312G25 QNH 3Ø.Ø4
```

This Plain Language Terminal Forecast is for Navy Norfolk and covers a 24-hour period from 0900Z to 0900Z. The forecast for 0900Z to 1200Z

is for 1500 feet scattered 8000 feet broken, and visibility 15 miles. The surface wind is forecast to be from 180° at 10 knots. The 1500-foot scattered layer will be variable to broken. The lowest forecasted altimeter setting is 30.02 Hg.

From 1200Z to 1500Z, the ceiling is forecast to be 1500 feet broken with an 8000-foot overcast layer above. Visibility is expected to be 5 miles in haze. Expected winds are 180° at 10 knots. Remarks indicate that widely scattered thunderstorms, with 1000-foot overcast ceilings and visibility of 2 miles in rain showers are expected in the general vicinity and there is only a slight chance that they will affect the station itself. The lowest forecasted altimeter setting for this period is 30.00 Hg.

The forecast for 1500Z to 1700Z is 1500 feet overcast with visibility 3 miles in light rain and fog. Occasionally during this period, ceilings are expected to lower to 800 feet overcast with visibility reduced to 1 mile in moderate rain and fog. The lowest forecasted altimeter setting is 29.99 inches.

From 1700Z to 1900Z the ceiling is expected to be 500 feet overcast and visibility 3/4 mile in moderate rain and fog. During this period, however, the visibility is expected to be variable between 1/2 and 1 mile. The wind is forecast to be 180° at 10 knots. The lowest forecasted altimeter setting is 29.98 Hg.

From 1900Z to 2100Z the forecasted ceiling and visibility are 2500 feet overcast and 5 miles in light rain and fog. For temporary periods during this time, the ceiling is expected to lower to 1500 feet overcast with visibility reduced to 3 miles in moderate rain and fog. A shift is expected with winds shifting to 230° at 15 knots. The lowest forecasted altimeter setting is 29.98 Hg.

From 2100Z to 2300Z, the ceiling and visibility are expected to gradually become 1500 feet overcast and 1 mile in thundershowers. The winds are expected to become 230° at 15 knots with gusts to 25 knots. The lowest forecasted altimeter setting is 29.97 inches.

At 0000Z a cold front is expected to pass through the area with conditions improving to 2000 feet scattered 8000 feet broken with visibility 10 miles after frontal passage. The wind should veer to 320° at 12 knots with gusts to 30 knots. The altimeter setting is expected to rise to 30.01 inches.

From 0300Z to the end of the forecast period at 0900Z, the conditions are expected to be clear with 10 miles visibility and surface winds 330° at 12 knots with gusts to 25 knots. The lowest altimeter setting is expected to be 30.04 Hg.

FLIGHT ADVISORIES

Flight advisories contain information on weather developments that are considered to be potentially hazardous to aircraft in flight. Flight advisories are issued in two categories. These categories are: SIGMETs (Significant Meteorological Information) and AIRMETs (Airman's Meteorological Information).

Significant Meteorological Information (SIGMET)

A SIGMET (WS) is issued when weather that is or expected to be so severe that it is considered to be potentially hazardous to all aircraft. Such weather conditions include:

1. Tornadoes
2. Lines of thunderstorms (squall lines)
3. Embedded thunderstorms
4. Hail 3/4 inch or more in diameter
5. Severe and extreme turbulence
6. Severe icing
7. Widespread dust storms/sand storms lowering visibility to less than 3 miles

The SIGMET is normally valid for up to 4 hours unless canceled earlier. Flight Service Stations (FSS) will broadcast SIGMETs upon receipt and at 15-minute intervals at H+00, H+15, H+30, and H+45 for the first hour and thereafter at H+15 and H+45 during the time the advisory is in effect. Air traffic control facilities <u>should</u> broadcast a SIGMET at least once on all frequencies.

Airman's Meteorological Information (AIRMET)

AIRMETs (WA) are issued when weather that is or is expected to be potentially hazardous to light aircraft. This includes:

1. Moderate icing
2. Moderate turbulence over an extensive area

3. Extensive areas of visibility less than 3 miles with ceilings of less than 1000 feet, including mountain ridges and passes
4. Winds of 30 knots or more within 2000 feet of the surface

AIRMETs are valid for up to 6 hours after being issued unless they are canceled earlier. FSS will broadcast AIRMETs when they first receive them and at 30-minute intervals, at H+15 and H+45, during their valid period.

Hurricane Advisories (WH)

Weather warnings or advisories of tropical phenomena, such as hurricanes and typhoons, are routinely provided to Navy activities ashore by the Naval Oceanography Command Activities at Norfolk, Pearl Harbor, and Guam. These advisories are issued at 6-hour intervals throughout the life of a tropical storm, and contain information on the size and position of the storm, the maximum winds, and the storm's predicted movement. Your particular station will have a hurricane evacuation bill which will specify the action to be taken in each stage of the storm's development.

Severe Weather Outlook Narrative (AC)

The Severe Local Storms (SELS) forecast unit of the National Severe Storms Forecast Center at Kansas City, Missouri, issues the AC as needed. These forecasts describe, in plain language, the prospects of severe weather and thunderstorm development during the next 24 hours. These forecasts are very helpful when the next day's flight operations are being scheduled.

Severe Weather Watch Bulletin (WW)

These forecasts or bulletins are unscheduled and are issued as the situation warrants. They provide advance warning to the aviation community as well as the general public, that severe weather conditions such as severe thunderstorms and tornadoes can be anticipated within a particular geographical area. The Severe Storms Forecast Center issues a watch at any time the location, time, and severity of the weather become evident.

Detailed information on hourly weather observations, advisories, forecasts, and reports may be found in the Federal Meteorological Handbook Number 1 (FMH #1), the Flight Services Handbook 7110.10, and the Data Communications Handbook 7110.80. The FMH #1 is prepared by an interagency group which represents the National Weather Service, the Department of Defense, Naval Oceanography Command and Air Weather Service, and the Department of Transportation (FAA).

In addition to becoming familiar with these manuals, you should visit the Naval Oceanography Command Detachment office located at your base and observe first hand the techniques used in observing and disseminating meteorological observations.

EXERCISE

4-23. State when the visibility and wind would be included in FT and FA forecasts.

4-24. What is the valid time of a Terminal Forecast?

4-25. In what/which forecast(s) would you find a brief description of expected front movements?

4-26. What forecast code/format has been adopted by Naval Oceanography Command activities, located within the United States, for pilot briefings?

Use the PLATF for Navy Norfolk on page 4-21 for reference in answering questions 4-27 and 4-28.

4-27. During what period of time is Navy Norfolk expected to be IFR (ceiling less than 1,000 feet and/or visibility less than 3 miles)?

4-28. During what period of time are the lowest ceiling and visibility expected to occur?

4-29. What conditions require the issuance of a/an (a) AIRMET? (b) SIGMET?

4-30. Describe the broadcast procedures for (a) AIRMETs. (b) SIGMETs.

4-31. List two conditions that would require the issuance of a Severe Weather Watch Bulletin (WW).

CHAPTER 5

MILITARY AIRCRAFT PERFORMANCE AND CHARACTERISTICS

In your study of the *Airman* Rate Training Manual (NAVEDTRA 10307) and the *Basic Military Requirements* Rate Training Manual (NAVEDTRA 10054), you learned aircraft designations and the basic fundamentals of flight. The intent of this chapter is to further your knowledge of aircraft characteristics and their performance and maneuvering limitations; however, for your convenience, we are starting with a brief review on aircraft designations.

AIRCRAFT DESIGNATION

Learning Objective: **Identify aircraft by their designations.**

All aircraft of the Armed Forces have tri-service designations, which means that whether a particular type of plane is used by the Navy, Army, or Air Force, or by all three services, it has the same basic identification symbol. The system uses letters to show basic mission, modification of basic mission, design modification, and special functions of the aircraft. A figure indicates the number of times the basic design was changed.

Each symbol contains a hyphen. The key to learning the system is to remember that the letter immediately preceding the hyphen represents the basic mission of the aircraft. A second letter appearing before this letter signifies a modification of basic mission. A third letter, introducing these two, denotes a special usage of the aircraft. After the hyphen is the design number. The letter after this design numeral specifies, by alphabetical sequence, the number of times the design was modified. Table 5-1 lists current aircraft designations.

The table may seem backwards, having the basic mission last, but the list is in the order in which all applicable symbols would appear. Following are two examples to help you understand the system. The first is for a basic aircraft.

F-4 F

- Basic mission (Fighter) — F
- Fourth design — 4
- Sixth modification — F

The next example is for a plane whose basic mission was changed.

E A - 6 B

- Mission modification (Special electronic equipment installation) — E
- Basic mission (Attack) — A
- Sixth design — 6
- Second modification — B

EXERCISE

In items 5-1 through 5-4 refer to table 5-1 and the military aircraft designation EA-6B. Select

Table 5-1.—Aircraft Designations

Special Status

G	Permanently grounded. (For instruction and ground training purposes.)
J	Special test, temporary. (Modified for special testing. Upon completion of tests, plane will be restored to its original design.)
N	Special test, permanent. (Permanently modified for testing.)
X	Experimental. (Not yet adopted for service use.)
Y	Prototype. (Purchased in limited numbers for complete testing of design.)
Z	Planning. (Indicates aircraft is in early stages of planning or development.)

Mission Modification

A	Attack
C	Cargo/transport.
D	Director. (For controlling drone aircraft or missiles.)
E	Special electronic installations (e.g., for airborne early warning).
H	Search/rescue.
K	Tanker.
L	Cold weather plane. (For arctic or antarctic operations.)
M	Missile carrier.
Q	Drone.
R	Reconnaissance.
S	Antisubmarine.
T	Trainer.
U	Utility.
V	Staff.
W	Weather.

Basic Mission

A	Attack.
B	Bomber.
C	Cargo/transport.
E	Special electronic installation.
F	Fighter.
H	Helicopter.
K	Tanker.
O	Observation.
P	Patrol.
R	Reconnaissance.
S	Antisubmarine.
T	Trainer.
U	Utility.
V	VTOL and STOL. (Planes designed for vertical takeoff and landing. Also aircraft capable of taking off and landing in a minimum prescribed distance.)
X	Research.

from column B the meaning of each symbol listed in column A. You may use the meanings in column B more than once.

	A.	B.
5-1.	E	1. Basic and/or modified mission symbol
5-2.	A	2. Modified design symbol
5-3.	6	3. Modified mission symbol
5-4.	C	4. Design symbol

5-5. What modified mission symbol is used to identify an aircraft used for in-flight refueling?

PERFORMANCE AND MANEUVERABILITY

Learning Objective: **Recognize aircraft performance and maneuverability capabilities.**

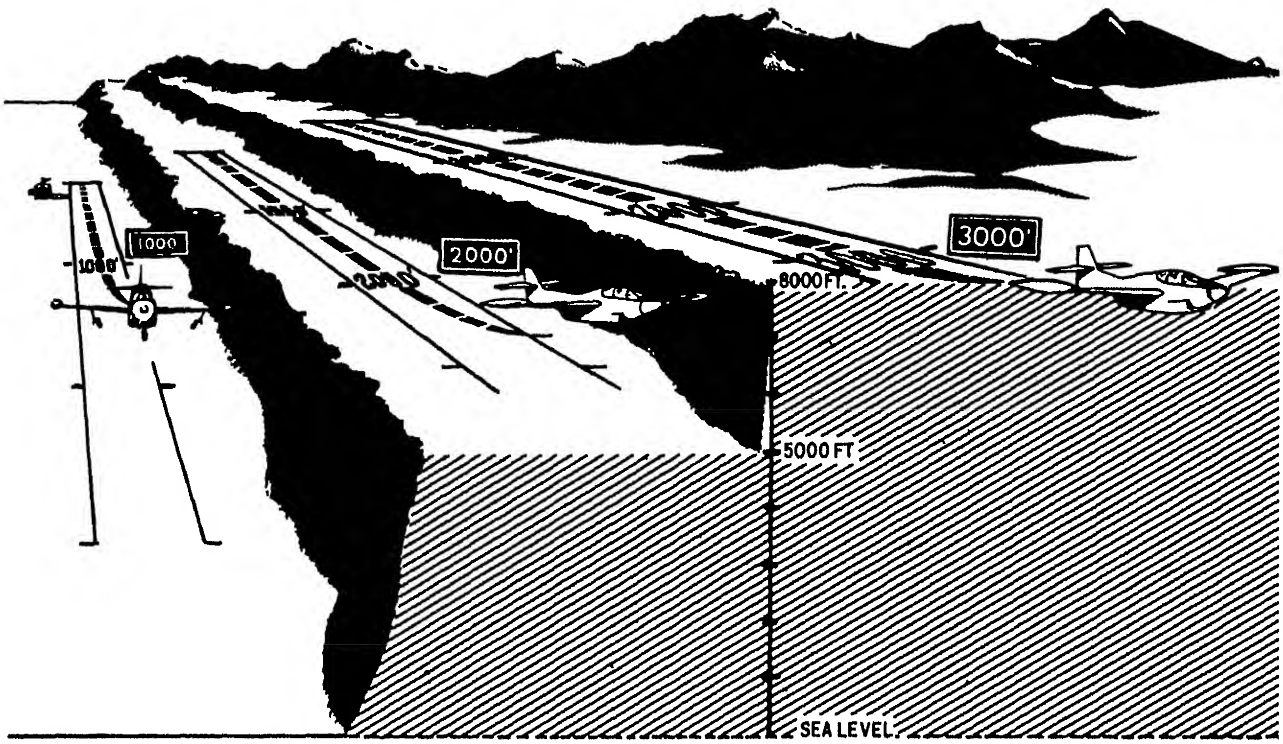
EFFECTS OF FIELD ELEVATIONS AND TEMPERATURE

Control tower operators issue clearances that in their opinion can be safely followed without collision hazard if reasonable caution is exercised by the pilot. The clearance issued is permissive in nature and does not relieve the pilot of responsibility for cautious handling of the aircraft. The information and clearances issued are intended to aid pilots to the fullest extent in avoiding collisions; this goal requires correct and concise instructions based on sound judgment for an effective flow of air traffic.

Normally, single-engine aircraft (as a class) are comparatively small and require less operating space around the airport than the large multi-engine aircraft. However, some of the single-engine jet aircraft do require a rather wide approach due to their high landing speeds.

Multi-engine aircraft (as a class) are normally larger than the single-engine types. They require approaches that are much wider and a final approach which is much longer. Each has a separate landing or takeoff requirement as they rarely perform these functions in formation; whereas, in the case of the single-engine aircraft, many landings and takeoffs may be completed in formation.

It is difficult to make generalizations concerning the performance and maneuverability of various aircraft, as each type has its own set of characteristics governing its performance both in the air and on the ground. Jet aircraft (as a type) require less warmup time than reciprocating engine types. The jets are extremely uneconomical to operate on the ground and at altitudes under those for which they were designed to operate. Their landing and takeoff speeds are universally higher, some require the use of drogue chutes for landing and afterburners for takeoff on most present-day airfields. Field elevations and runway temperatures are vital elements in control of jet aircraft and, to a somewhat lesser degree, in the control of reciprocating engine aircraft. As an example of what effect altitude has on even a light aircraft, it may be startling to learn that an aircraft of this type which has a rate of climb of 420 feet per minute at sea level has its rate of climb reduced to 225 feet per minute at 5,000 feet. Also, the distance needed for takeoff is doubled between these two altitudes. (See figure 5-1.) Higher temperatures and higher humidity have similar effects on aircraft performance. A high-performance jet fighter quite possibly may not operate from an airfield with short runways on a day on which high runway temperatures prevail, even though the field elevation is only moderately high. Later in the afternoon, or at night, the same fighter may be able to effect a takeoff from the same field, because as a general rule the atmosphere cools and becomes more dense during night hours. More lift is afforded the aircraft in



201.3

Figure 5-1.—Comparison of takeoff distances with increased altitudes.

dense air, whether it is a light aircraft or a high-performance jet.

EFFECTS OF WAKE TURBULENCE

Cognizance of the hazards to aircraft on the ground and in the air, which are caused by wake turbulence from heavy aircraft, is of the utmost importance. Large aircraft can create wake turbulence severe enough to endanger light aircraft, particularly in light wind conditions, as this turbulence may remain in the approach and landing area for several minutes. Turbulence may be encountered by all types of aircraft when landing or crossing the wake of large aircraft.

Since the existence and effect of wake turbulence are unpredictable, you as an AC are not responsible for anticipating the need for such information in all cases. However, you must be especially alert for a situation wherein the possibility of aircraft under your jurisdiction encountering wake turbulence exists and ensure that the affected pilots are advised. This enables the pilot to avoid the suspected hazardous area and enhances the safety of the flight.

Turbulence generated by aircraft, which was once thought to be propwash, is now categorized as "thrust stream turbulence" and "wingtip vortices". These categories of turbulence are collectively termed WAKE TURBULENCE. Thrust stream turbulence is associated with ground operations, such as taxiing and warmup operations.

Wingtip vortices are trailing masses of disturbed air created by the wing of an aircraft as it produces lift. An aircraft creates two such vortices with rotational air movement, one trailing each wingtip. Once formed, the vortices extend and may be hazardous for an undetermined distance behind the generating aircraft. The turbulence is directly related to the weight, wing span, and speed of the aircraft. Its intensity is directly proportional to the weight, and inversely proportional to the wing span and speed of the

aircraft. The heavier and slower the aircraft, the greater is the intensity of the turbulence. Thus, modern large transport aircraft create maximum turbulence during takeoff and landing at or near maximum gross weights. The manner in which wake turbulence is generated is illustrated in figure 5-2.

Trailing vortices have certain behavioral characteristics which can help a pilot visualize the wake location and thereby take avoidance precautions:

1. Vortices are generated from the moment the aircraft leaves the ground, since trailing vortices are a by-product of wing lift (see figure 5-3).

2. The vortex circulation is outward, upward, and around the wing tips. Tests have shown that the vortex flow field covers an area about two wing spans in width and one wing span in depth.

The vortices remain so spaced (about a wing span apart), even drifting with the wind, at altitudes greater than a wing span from the ground. Vortices from large aircraft sink at a rate of about 400 to 500 feet per minute. They tend to level off at a distance about 900 feet below the flight path of the generating aircraft. When the vortices of large aircraft sink close to the ground (within about 200 feet), they tend to move laterally over the ground at a speed of about 5 knots. (See figure 5-4.)

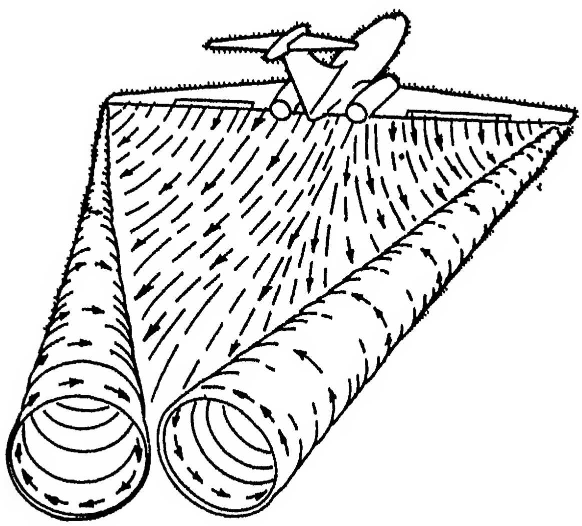


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Figure 5-2.—Vortex generation.

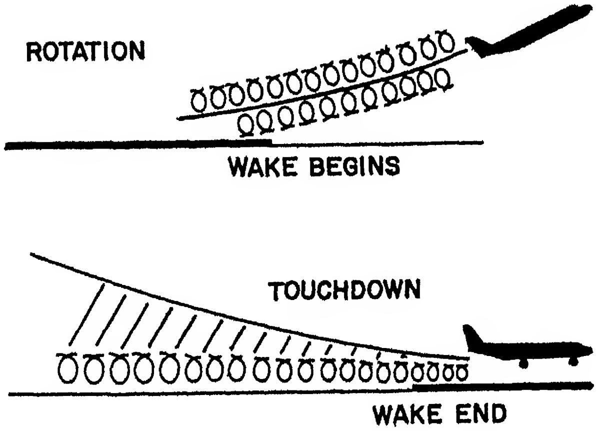

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Figure 5-3.—Beginning and ending of vortex generation.

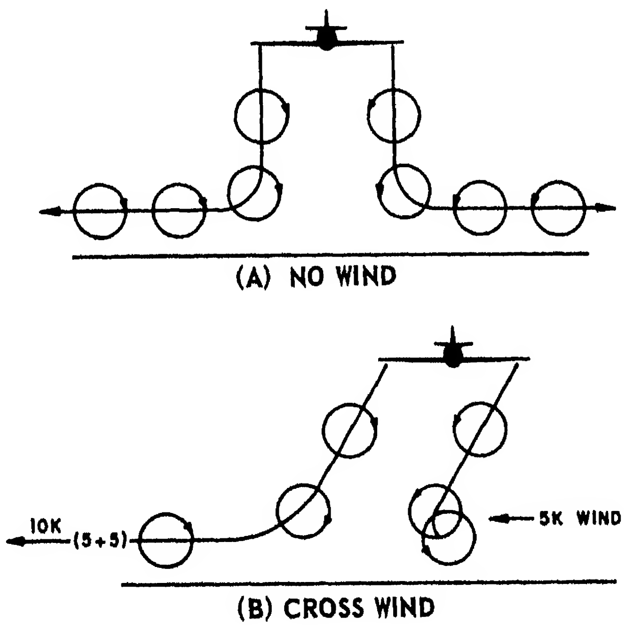

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Figure 5-4.—Vortex movement in ground effect: (A) no wind; (B) cross wind.

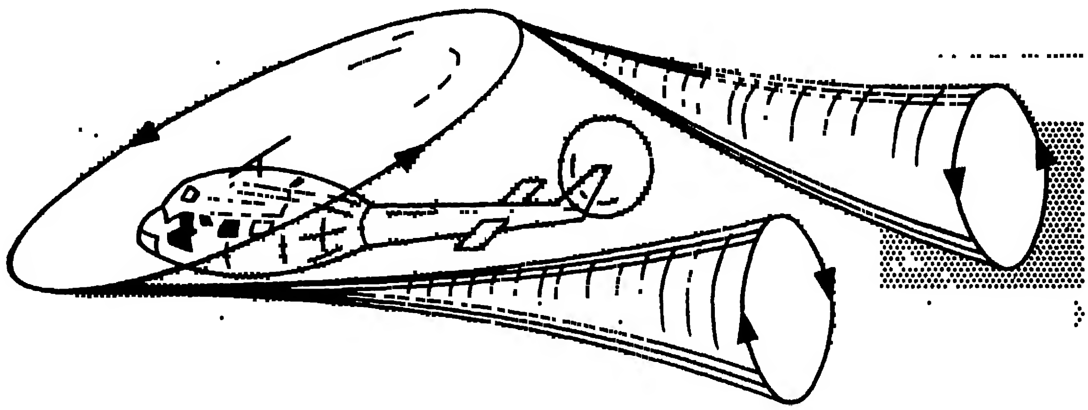


Figure 5-5.—Helicopter generated trailing vortices.

Helicopters also generate turbulence. A hovering helicopter generates a downwash from its main rotor(s) similar to the propwash of conventional aircraft. In forward flight, however, this energy is transformed into a pair of trailing vortices similar to wingtip vortices of fixed-wing aircraft. (See figure 5-5.)

If you should foresee the possibility of wake turbulence, cautionary information should be issued to the pilot of the aircraft concerned. Refer to ATP 7110.65 (Series) and chapters 10 and 12 of this manual for cautionary advisory phraseology to be employed for Heavy Aircraft operations.

EXERCISE

5-6. What effect do high field elevation, temperature, and humidity have on jet aircraft operations?

5-7. What categories of turbulence are collectively termed wake turbulence?

5-8. The generation of wake turbulence is directly related to what three factors?

AIRCRAFT CHARACTERISTICS

Learning Objective: **Recognize aircraft operational characteristics.**

GENERAL CHARACTERISTICS OF MILITARY AIRCRAFT

In order to give service to aircraft you control, you must know something of their characteristics and limitations. This knowledge not only enables you to appreciate some of the problems that confront the pilot, but makes your job easier and gives you confidence in your ability. Although the subject of aircraft accidents is an extremely unpleasant one, we must be concerned with it. After all, preventing accidents is the basis for air traffic control. With this in mind, let us consider the critical phases of flight where the aircraft is least maneuverable and where the majority of accidents occur—during landing and takeoff.

Often you control several aircraft at once, and it is your responsibility to provide separation between them to prevent collisions. A knowledge of the speed, rate of climb and descent, rate of turn, and maneuverability of different aircraft is vitally important. With this knowledge you can anticipate which aircraft will arrive first at a certain point, or which aircraft can safely make a sharp turn. Thus you can provide the safe, positive control that is necessary.

One great concern in air traffic control is speed. Speeds of conventional-type aircraft vary widely, but differences between conventional and jet aircraft are even greater. You certainly cannot control an F-4 in the same manner that you control a T-34C.

Speeds

Traffic pattern speeds are of primary interest since most of your duties are in terminal control facilities. (See Table 5-2.) One particular portion of the traffic pattern which is of utmost importance to everyone is the final approach course. It is in this area where most accidents or incidents occur. To a large extent, these are the result of incorrect sequencing technique, failure to issue timely information, and failure to consider approach speeds when issuing a landing sequence. Here is a typical example of an actual incident. A T-2C was "cleared touch-and-go number one" by the tower. The T-2C was executing a normal approach at approximately 93 knots. An instructor pilot in the rear seat of a TA-4J was demonstrating an abeam approach procedure. The TA-4J was "cleared touch-and-go number two" by the tower. The instructor of the TA-4J heard his clearance for touch-and-go but failed to pick up the fact that he was number two on approach. With both aircraft on final approach, the TA-4J passed directly over the T-2C at about 25 feet. Both aircraft touched down on the runway, the TA-4J in front of the T-2C, and both lifted off again on their touch-and-go landings. The TA-4J never saw the T-2C. Additionally, the aircraft had dissimilar airspeeds (the TA-4 being much faster) and pattern descent rates. Without getting into all of the right and wrongs of the case, let's just take it for the lesson it teaches—due consideration must be given to approach speeds and other operational characteristics when assigning landing sequences.

Briefings are given by local pilots on the operational characteristics and limitations of various aircraft assigned to your base. This is usually an annual affair. Attend them and pay attention to these indoctrinations—especially the approach speeds of the aircraft. It may keep you from being involved in an incident like the one we described.

Rates of Climb and Descent

In control positions it is often necessary to direct pilots to make altitude changes in order to maintain proper separation between flights. Therefore, it is necessary that you have some idea of what performance rates are within the capability of particular aircraft. Being so enlightened, you would not direct or expect excessive performance from the aircraft you control. The figures we give you here are approximate for normal operating conditions. However, for ATC purposes all possible related factors such as weather, type of flight, and fuel status must be considered when anticipating separation based on normal climb or descent characteristics of aircraft. Generally speaking, conventional type aircraft climb/descend at rates varying from 500 to 2000 feet per minute (FPM), whereas jets vary from 3000 to 5000 FPM. These reflect day-to-day operating ranges, and should not be confused with maximum performance rates.

What we are really interested in is that you apply good control techniques when you operate and that you be knowledgeable enough to alert others, should the occasion arise, to unrealistic requirements placed on pilots. Consider a departure controller directing a departing aircraft to a fix where existing conditions require that the aircraft be at a specified altitude before reaching this fix. If the flight were an air evacuation flight with patients aboard, its rate of climb would certainly be lessened. The controller should recognize this fact. Instead of "driving" the aircraft straight to the fix, he should determine, by asking the pilot if he can reach the altitude and be responsive to any request for more climbing time.

Fuel Consumption

An important characteristic of jets is their high rate of fuel consumption, especially at low altitudes and while operating on the ground. Ideally, they should be off the ground as soon as possible after starting engines, especially in the case of fighters. Their normally short-range capability coupled with an air traffic control delay could hamper the mission. It is with reference to

Table 5-2.—Normal radar traffic pattern speeds

Type	Non-Landing Configuration	Landing Configuration	Normal Radar Final IAS	Weight Class %
A-3*	230	150	125-132	L
A-4*	220-250	125-150	125-130	L
A-6*	230-250	135-140	125-130	L
A-7*	220-250	125-150	125-140	L
A-10*	150	125	125-130	L
A-37*	170-180	130	120-130	S
AV-8*	250	160	160	L
C-130	155	140-155	140	L
C-12	140	130	130	S
E-2	150	130	100-110	L
F-4*	230-250	150	140	L
F-8*	250-260	150	150	L
F-18*	220-260	160	120-140	L
F-105*	250	195	195	L
F-14*	220-250	130-140	120-135	L
H-1	70	70	50	S
H-2	65	65	55	L
H-3	70	70	40	L
H-46	70	70	70	L
H-53	70	70	70	L
H-58	70	70	70	S
OV-1	140	120	120	L
OV-10	150	110-120	110	S
P-3	160	140	140	L
S-3	220-230	160-185	105-125	L
T-2*	200	100	100	S
T-34C	150	120	100	S
T-38*	250	180	160	S
T-39	220-230	150	120-130	S

* Indicates single piloted military turbojet aircraft.

% Weight class listings (S for small and L for large) are used for wake turbulence separation purposes only.

jet fighters and trainer aircraft that we address our comments here.

The fuel consumption rate of jets varies, of course, but we offer the following rule of thumb as a guide line. A typical jet fighter uses its fuel up at a rate approximating 100 pounds per minute; for comparison, 133.5 pounds of turbine fuel equals 20 gallons. Since this consumption rate is higher at low altitudes and fighters often have little fuel left on arrival at their destination, fighter pilots prefer to remain at high altitudes as long as possible. So, you can readily see that you must anticipate and plan your activities to prevent undue delays in handling jet traffic. Also, local directives may give jets priority over conventional aircraft, except of course for emergencies. Therefore, your job is to adhere to established base traffic priority procedures as close as you can, and to help a jet conserve fuel by not unduly delaying its operation or, if unavoidable, by promptly advising the pilot of the situation.

Occasionally, you may hear a pilot declare "minimum fuel." Do not confuse this report with a "low fuel" state report which is an emergency. "Minimum fuel" indicates that the aircraft's fuel supply has reached a state where upon reaching the destination, the pilot can accept little or no delay. However, if the "minimum fuel" aircraft is given a go-around or executes a missed approach, it could become an emergency. If, at any time, the remaining usable fuel supply suggests the need for traffic priority to ensure a safe landing, the pilot should declare an emergency with ATC and report, in minutes, the amount of fuel remaining. It is not necessary to discontinue other approaches or landings and give the "minimum fuel" aircraft priority, but if you have a traffic confliction or you anticipate a confliction, the "minimum fuel" aircraft should be given preference.

SELECTED NAVY AIRCRAFT

The following paragraphs contain certain characteristics of some of the Navy's aircraft. Not all of the aircraft that you may be called upon to control are covered; however, a good cross section is presented. Keep in mind that memorizing the exact figures is not important, but they are used in this text to show the type of comparison a controller would make when issuing instructions. If all aircraft in your landing pattern were high-performance aircraft, then spacing problems of one aircraft relative to another would be less than is the case when high-performance and cargo-type aircraft are using the same runway.

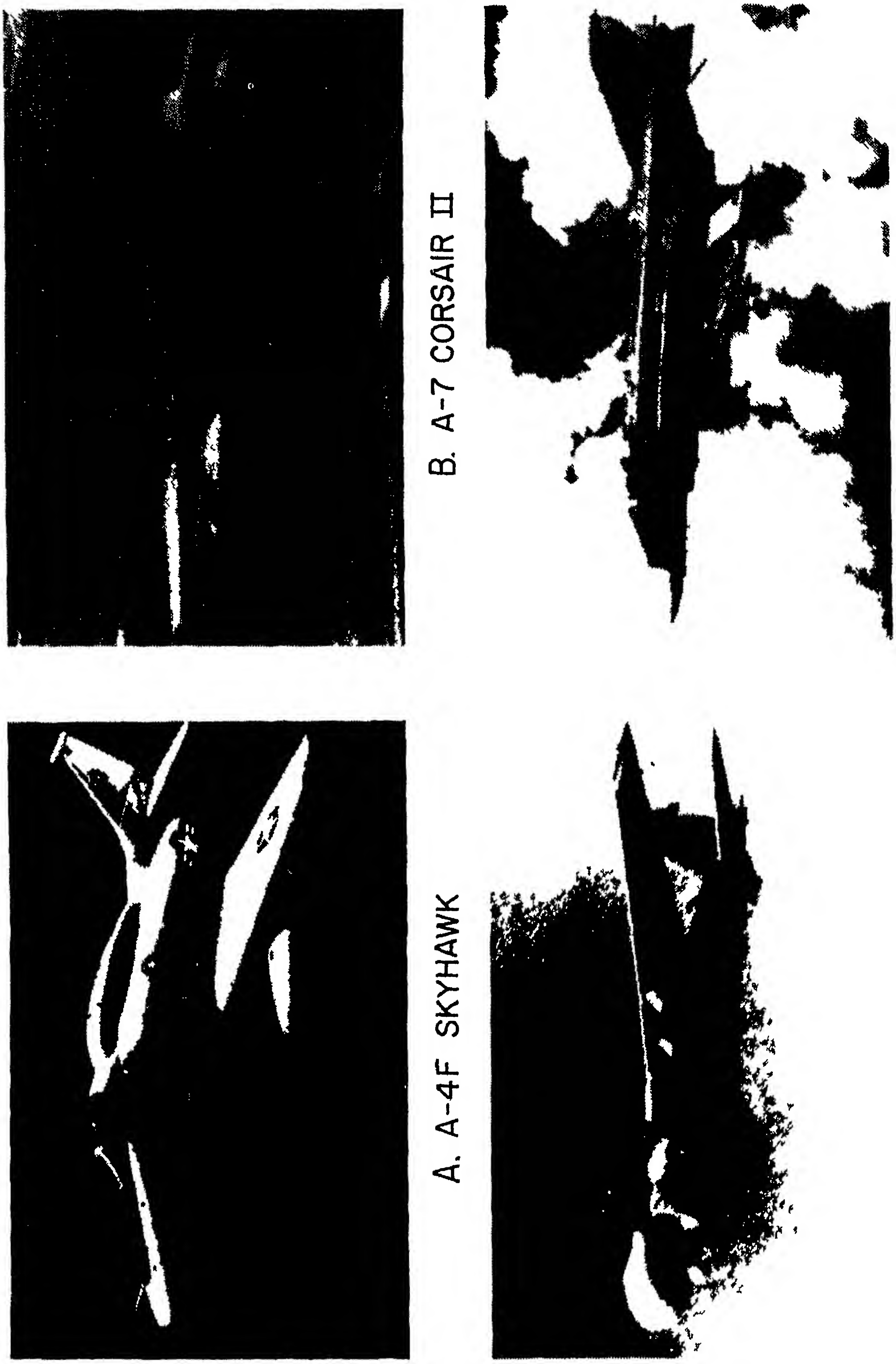
The A-4 is considered a high-performance aircraft with a cruising speed in excess of 500 knots at altitude and a final approach speed of 125-130 knots. One problem of particular importance is the effect of a crosswind on landing due to the configuration of the landing gear. Pilots of A-4s are listening intently for the wind direction and velocity since the gear is rather high and close together and presents a problem of stability after the aircraft has touched down on the runway under crosswind conditions. (See (A) in figure 5-6.)

The A-7 is a high-performance type, and also cruises in excess of 500 knots at altitude. The A-7 lands rather fast with a final approach speed of approximately 125-140 knots. (See (B) in figure 5-6.)

The A-6 has a cruising speed of about 420 knots but is an extremely stable aircraft at landing speed (125-140 knots) with a stall speed of about 70 knots, which is comparable to the E-2. This would allow the A-6 to mix with the slower types of aircraft without too much concern about overtaking other traffic. (See (C) in figure 5-6.)

The F-4 is a high-performance aircraft with a maximum speed of over Mach 2. Its approach speed is approximately 140 knots, which is comparable to most jet fighter-type aircraft. Two engines with afterburners enable it to take off in about 5,000 feet, while it has good slowdown capability when back on the runway by being able to land in about 3,000 feet. (See (D) in figure 5-6.)

The P-3 has four turboprop engines, can take off in about 3,700 feet, and climb at a rate of 1,500 feet per minute. It cruises at approximately 350 knots at altitude and has good endurance capability, being able to operate for 17 hours on two engines. Although the P-3 has a rather fast final approach speed, 140 knots, its reversible pitch propellers enable it to stop in a short distance after landing. This could allow for a quick turn off the duty runway. (See (A) in figure 5-7.)



A. A-4F SKYHAWK

B. A-7 CORSAIR II

C. A-6 INTRUDER

D. F-14 PHANTOM

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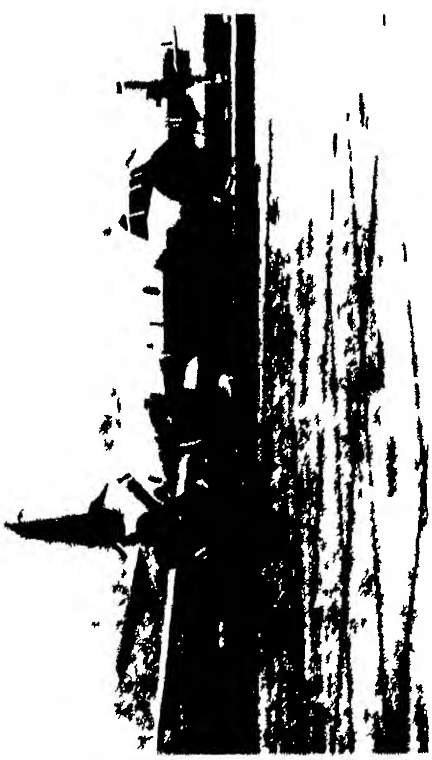
Figure 5-6.—Representative types of naval aircraft.


A. P-3 ORION


B. C-130 HERCULES


C. T-39 SABERLINER


D. S-3A VIKING

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Figure 5-7.—Representative types of naval aircraft.

The C-130 also has four turboprop engines and is a cargo-type aircraft with a cruising speed of approximately 350 knots. It lands at about the same speed as the P-3 and has a stall speed of approximately 100 knots. It can take off in about 3,500 feet, and with the reversible pitch propellers can land and stop in about 2,200 feet. This enables it to clear the runway unusually fast for a large aircraft. (See (B) in figure 5-7.)

The T-39 Saberliner is a twin-jet aircraft which was originally designed to train radar intercept operators; it can fly at speeds in excess of 350 knots and has a landing speed of approximately 120-130 knots. (See (C) in figure 5-7.)

The S-3A aircraft is a high subsonic, all weather, long range jet which was designed to seek out and destroy enemy submarines. The S-3A airframe, with modifications, can be used as a carrier onboard delivery (COD) aircraft to transfer personnel and cargo from ship to shore. Both modifications can operate comparably with A-6 aircraft. (See (D) in figure 5-7.)

The T-2 is a jet trainer aircraft and is relatively fast with a cruising speed of over 450 knots. However its straight wing design allows for more stable training operations and a much slower landing speed of 100 knots. (See (A) in figure 5-8.)

The E-2 is a turboprop aircraft with a cruising speed of approximately 280 knots. It can slow down very effectively for the landing approach with a landing speed of approximately 100-110 knots and a stall speed of approximately 70 knots. (See (B) in figure 5-8.)

The Navy's T-34C is used to train Navy pilots. This turboprop aircraft has a maximum speed of about 200-215 knots, a landing speed of 100 knots, and a stall speed of about 60 knots. Its uses include acrobatics, confidence maneuvers, and instrument and night training. (See (C) in figure 5-8.)

New aircraft are constantly undergoing test and evaluation for induction into the fleet. One of the newest of the Navy's aircraft is the F-14 Tomcat which was designed as a supersonic fighter-bomber aircraft capable of attacking and destroying targets in all weather conditions day or night. It is equipped with a variable position wing which allows it to achieve a great speed range and to operate comparably with other aircraft in terminal areas. (See (A) in figure 5-9.) The F-14s are replacing the F-4s in fleet use.

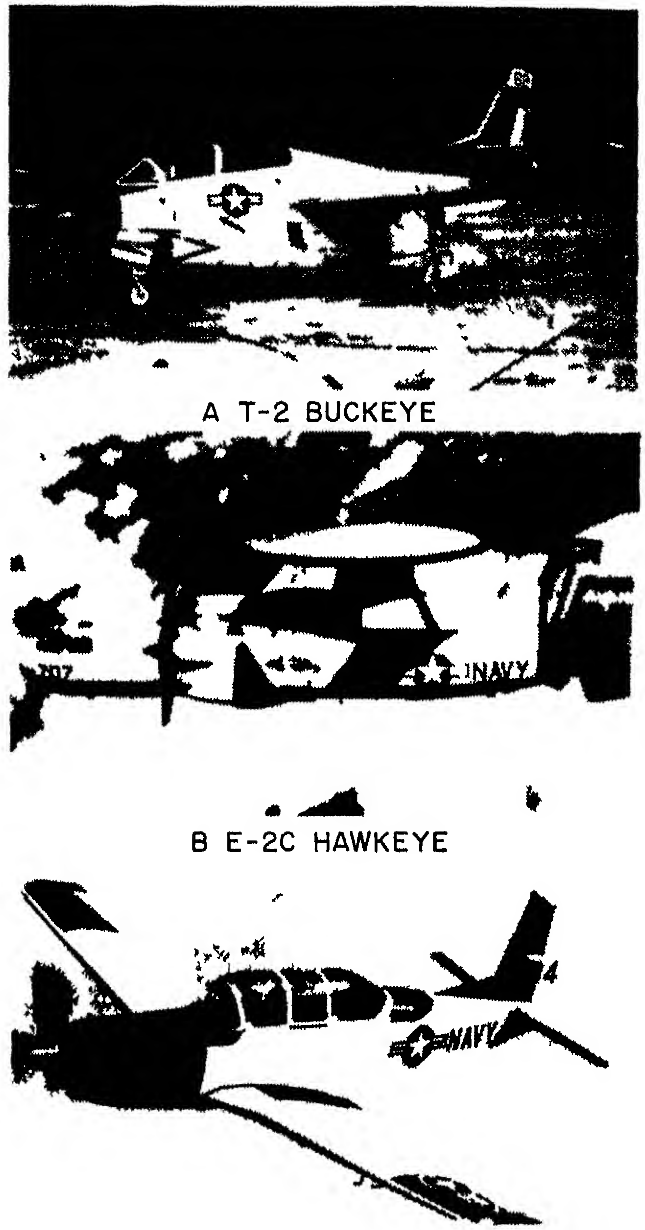

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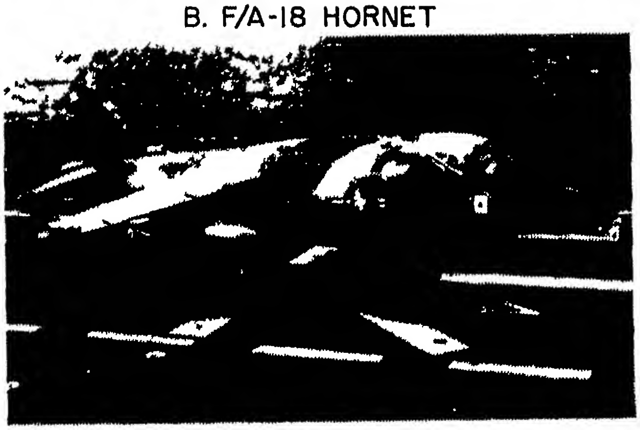
Figure 5-8.—Representative types of naval aircraft.

A. F-14 TOMCAT

B. F/A-18 HORNET



C. AV-8A HARRIER

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Figure 5-9.—Representative types of naval aircraft.

Another new aircraft is the F/A-18 Hornet. The F/A-18s are designed as multimission fighters and attack aircraft and are replacing the Navy's A-7s and the Marine Corps' F4s. The F/A-18 also is a supersonic aircraft which can operate comfortably with other jet aircraft. (See (B) in figure 5-9.)

Another of the Department of the Navy's latest aircraft is the AV-8A Harrier. This single seat, Vertical Takeoff and Landing (VTOL) aircraft has been assigned to Marine aviation units. (See (C) in figure 5-9.)

This unique attack aircraft has the capability to operate from unprepared fields and requires little takeoff and landing area due to its ability to land and take off vertically.

Maximum speed of the Harrier is listed at 625 knots with a range of 1,800 miles.

The Navy also has numerous helicopters in its fleet. These range from the giant CH-53 Super Stallion (see figure 5-10) which is used to transport cargo, personnel, and to recover downed or damaged aircraft, down to the TH-57A Jet ranger which is used for training. In addition to the obvious uses of helicopters—search-and-rescue and transport—Navy helicopters play a very important role in the defense of our Navy, nation, and world. They are being used for antisubmarine warfare, antiship surveillance, and targeting. Many helicopters, including the new SH-60B Seahawk Lamps III (see figure 5-11), are equipped with radar, computers, sonobuoys, and torpedoes. Refer to figure 5-12 for more of the Navy's helicopters.

We have not covered every aircraft in the Navy's inventory, nor have we covered all characteristics needed to handle successfully all

Figure 5-10.—Ch-53 Super Stallion. 201.270

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Figure 5-11.—SH-60B Seahawk Lamps Mk III.

types of aircraft which may come under your control. However, this brief overview should familiarize you with the many different types of aircraft which may come under your control. Again, you should attend the briefings given locally by pilots on the operational characteristics and limitations of the various aircraft assigned to your station or ship. You should also remain abreast of current and future developments relative to naval aircraft.

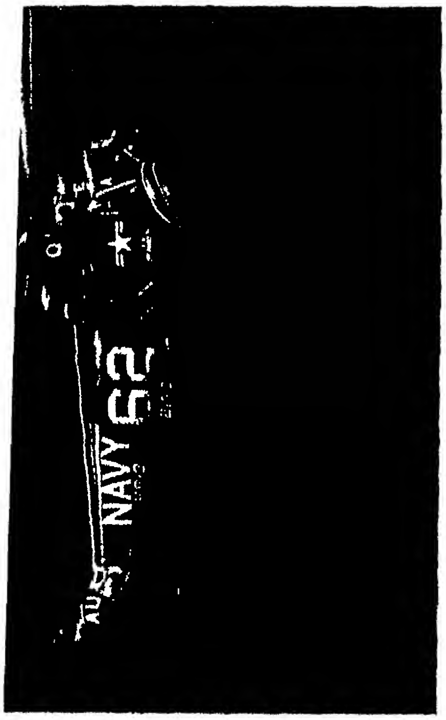
EXERCISE

5-9. What three operational characteristics must you consider when controlling aircraft?

5-10. List two ways you as a controller can help fighter pilots conserve fuel.

5-11. What phrase or statement made by a pilot would cause you to be more conscious of the aircraft's fuel status?

A. CH-46 SEA KNIGHT - TRANSPORT



B. SH-3A SEA KING - NAVY'S FIRST-LINE ASW HELICOPTER

C. UH-2C SEASPRITE - UTILITY

D. TH-57A JETRANGER - TRAINING

3.115

Figure 5-12.—Representative types of naval helicopters.

CHAPTER 6

AIR NAVIGATION AND AIDS TO AIR NAVIGATION

Air navigation has borrowed and adapted many of the instruments, practices, and procedures of marine navigation; thus, basic knowledge and skills are the same for marine and air navigation. It is necessary for you as an air traffic controller to understand some of the problems met by pilots in planning and completing a successful flight. In the performance of your daily duties, it is important that you have an understanding of the basic fundamentals of air navigation and the aids to air navigation. This chapter is intended to supply this need and should help to give you the confidence needed when called upon to give assistance to pilots.

BASIC CONCEPTS OF AIR NAVIGATION

Learning Objective: **Describe the fundamentals and terms of navigation and the fundamentals of plotting positions.**

Any purposeful movement in the universe ultimately involves an intention to proceed to a definite point. Navigation is the business of proceeding in such a manner as to arrive at that point. Air navigation is defined, formally, as the process of directing the movement of an aircraft from one point to another. Air navigation is used primarily to determine the direction necessary to accomplish the intended flight, locate positions, and measure distance and time as means to that end.

Position is a point defined by stated or implied coordinates. This term is often qualified by such adjectives as estimated, dead reckoning, no wind, etc., whose meanings are explained later in this chapter. But however qualified, the word position always refers to some place that can be identified. One of the basic problems of the navigator is that of fixing the aircraft's position. Unless this position is known, the navigator cannot know how to direct the movement of the aircraft to its intended destination.

Direction is the position of one point in space relative to another without reference to the distance between them. Direction may be either 3-dimensional or 2-dimensional, the horizontal being the usual plane of 2-dimensional direction. For example, the direction of San Francisco from New York is approximately west (2-dimensional); while the direction of an aircraft from an observer on the ground may be west and 20 degrees above the horizontal (3-dimensional). Direction is not itself an angle (that is, the direction east) but it is often measured in terms of its angular distance from a reference direction.

Distance is the spatial separation between two points and is measured by the length of a line joining them. This seems plain enough. Suppose, however, that the two points are on opposite sides of a baseball. How is the line to be drawn? Does it run through the center of the ball, or around the surface? If around the ball, what path does it follow? The term distance as used in navigation must be qualified to indicate how the distance is to be measured. The shortest distance on the earth's surface from San Diego to Sydney, Australia, is 6,530 miles. But via Honolulu and Guam, an often used route, it is 8,602 miles. And, besides, the length of the chosen line could be expressed in various units, as miles, kilometers, or yards.

Time has many definitions, but those used in navigation consist mainly of two: the hour of the day and an elapsed interval. The first is used to designate a definite instant, as takeoff time is 0215. The second definition is used to indicate an interval, as time of flight, 2 hours 15 minutes.

A map or a chart of the earth's surface is the primary tool used in air navigation. Without a chart it would be impossible to navigate. Therefore, it is important to understand certain facts shown on these charts about the earth's surface. Some of these will be familiar, others may not. To ensure that all are known, let us start from the beginning and review the facts.

The earth resembles a spinning ball. The imaginary line about which the earth rotates is called the axis of the earth. The ends of the axis are called the North Geographic Pole and the South Geographic Pole.

Although most people think of it as such, the earth is not a true sphere. A sphere is a body whose surface is equidistant from a point within, known as the center. Any line which passes from one side of a sphere through the center of the other side is a diameter of the sphere. Obviously, one diameter is equal to every other diameter.

The earth is slightly flattened at the poles. This causes its axis to be about 26 miles shorter than its greatest diameter. This difference, however, is only about 0.3 percent of the diameter. Therefore, for the purposes of navigation, the earth may be considered a true sphere.

POSITION

It is necessary to have a system for designating any position on the surface of the earth. Sometimes we may say that the aircraft is ten miles south of San Diego or that its destination is the municipal airport. Such designations may be clear and simple enough, but they would be useless in locating the aircraft's position while crossing the Atlantic Ocean. It would not be enough to say that the aircraft was in the middle of the Atlantic or 3 miles south of an iceberg. What is needed is a universal method of expressing position without regard to nearby geographic features.

To tell a stranger the location of a restaurant in Chicago, you might say that it is at the corner of 2nd Street and 3rd Avenue. This definitely tells the stranger the location, as there is only one place in all the city at which 2nd Street and 3rd Avenue cross. You might also say that the restaurant is two blocks north of Main Street and three blocks east of Broadway. This is just as definite. Quantities which give position with respect to two reference lines are called coordinates. Thus, "two blocks north" and "three blocks east" are the coordinates of the restaurant relative to Main Street and Broadway.

Positions on the earth may be given by a similar system of coordinates. However, since there are no natural lines on the earth to serve as reference lines, it is necessary to use imaginary lines.

Straight lines are usually the easiest with which to work. However, straight lines cannot be drawn on a curved surface. On a sphere, the easiest reference line is a circle.

Circles on a Sphere

If a sphere is cut straight through the center, the resulting cut edges are circles. Thus, the intersection of a plane with a sphere forms a circle. If the plane passes through the center of the sphere, dividing it in half, the circle formed is a great circle. (See figure 6-1.) A great circle is the largest circle which can be drawn on a given sphere. Any circle other than a great circle, no matter how large, is called a small circle. (See figure 6-1.) The plane of a small circle, of course, does not pass through the center of the sphere, and hence does not divide it into equal halves.

Segments of circles or arcs are measured in degrees, minutes, and seconds. A circle contains 360° of arc. Each degree (°) is 1/360 of the circumference of a circle. Thus, if any circle is divided into 360 equal arcs, each arc is 1° in length, regardless of the size of the circle. A minute (′) is 1/60 of 1°; a second (″) is 1/60 of 1′.

Notice in figure 6-2 that if a straight line is drawn from each end of an arc to the center of the circle, the two lines meet to form an angle at the center (angle ABC). This angle is subtended by the arc. Angles, like arcs, are measured in degrees, minutes, and seconds. The angle at the center of a circle (figure 6-2) always contains the same number of degrees, minutes, and seconds as the arc which subtends it.

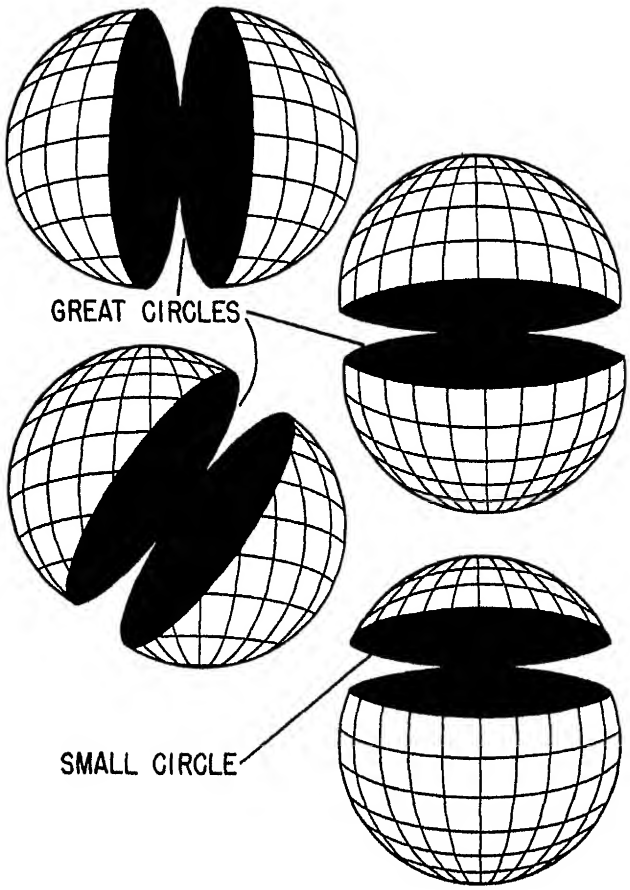


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Figure 6-1.—Circles on a sphere.

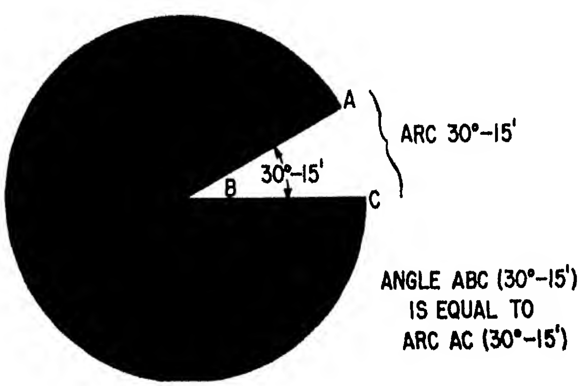

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Figure 6-2.—The angle at the center is equal to the arc.

Reference Lines on the Earth

As stated earlier in this chapter, circles make the best reference lines for designating position on a sphere. The question is where to draw the circles. A sphere is a continuous surface without beginning or end. On the earth the only distinctive natural geometric line is its axis, which is different from every other diameter by about 26 miles. Thus, the geographic poles are distinctive points on the earth. The geographic poles are used as the central points for one set of reference circles. The most important circle of this set is the Equator.

The Equator is the great circle halfway between the poles. Since the poles are 180°, or half a circle apart, every point on the Equator is 90° from each pole. The plane of the Equator is perpendicular to the earth's axis. The Equator divides the earth into northern and southern hemispheres. It is important to remember that the Equator serves as a reference line for denoting north and south latitude.

Any small circle on the earth whose plane is parallel with the plane of the Equator is called a parallel of latitude, or simply a parallel. Each parallel is everywhere equidistant from the poles, from the Equator, and from every other parallel. Thus, the parallels and the Equator are concentric about the polar axis. (See figure 6-3.)

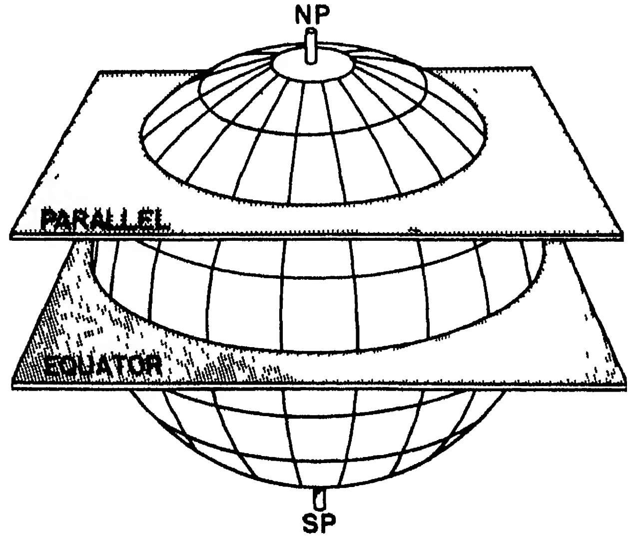

Figure 6-3.—Parallels of latitude. 201.73

Every point on the earth has a parallel passing through it. However, only a few of these parallels are shown on the globe. The globe would be solid black if they were all shown. Each parallel is designated by its angular distance north or south of the Equator—that is, toward the North or South Pole, as the case may be.

Points east or west on the earth are located by reference to a meridian of longitude, or simply a meridian. (See figure 6-4.) Instead of using small circles as in the case with latitude, the longitude system is based on great circles passing through the poles. These great circles are divided in half by the poles, and are farthest apart at the equator. Each half of the circle is assigned a value east or west.

The prime meridian is the meridian whose plane passes through the Observatory at Greenwich, England, which has been adopted as an origin for the measurement of longitude. This meridian is also referred to as the Greenwich meridian, and serves as our second reference line. (See figure 6-4.)

Latitude and Longitude

The parallels and meridians intersect at right angles to form a grid system comparable to the intersecting streets of a city. You can designate any position in a city by naming the streets which pass through it. Likewise, you can designate any point on the earth by naming the parallel and meridian which pass through it. Thus, the 29°59′ N parallel and the 95°21′ W meridian together designate Houston, Texas. (See figure 6-5.) Any point on the earth can be designated by giving its coordinates relative to the Equator and Greenwich meridian. These coordinates are called latitude and longitude.

The latitude of a point is its angular distance north or south of the Equator, measured in the plane of the meridian. It is measured from 0° at

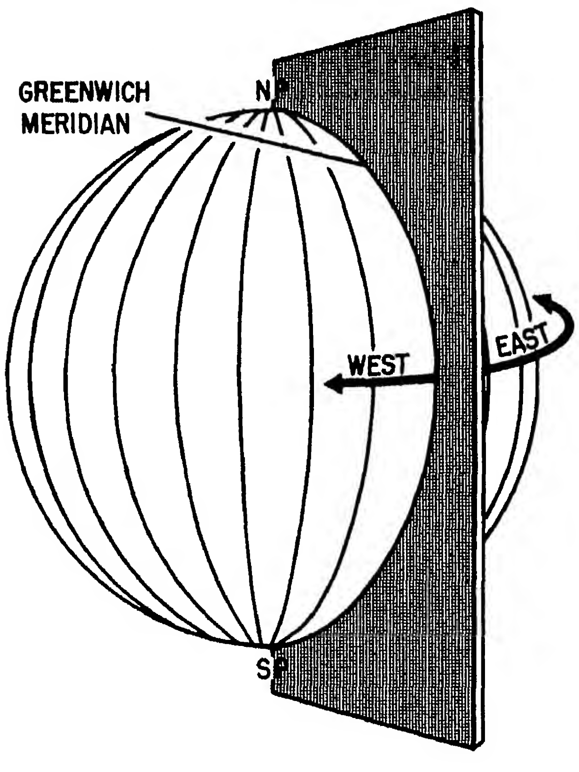

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Figure 6-4.—Meridians of longitude.

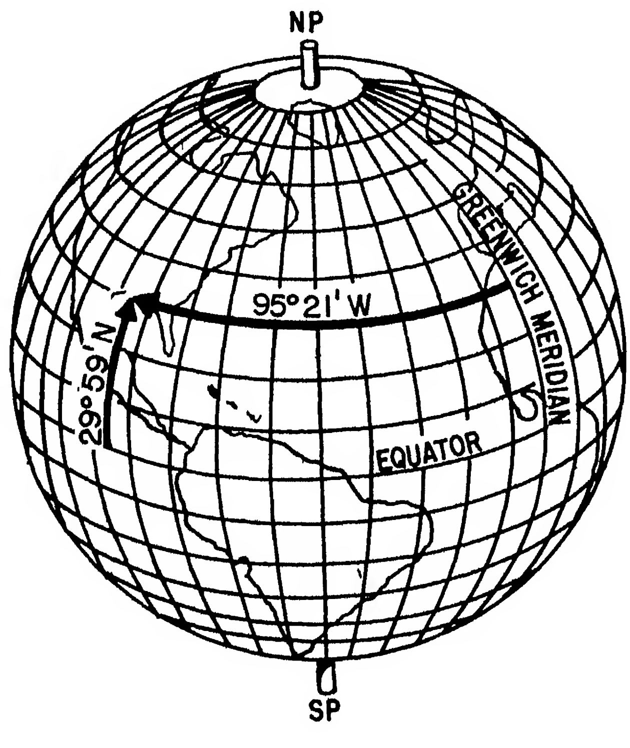

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Figure 6-5.—Position designated by coordinates.

the Equator, north to 90° at the North Pole, and south to 90° at the South Pole.

The longitude of a point is its angular distance east or west of the prime meridian, measured in the plane of the Equator or of a parallel. Longitude is measured from 0° to 180° east and from 0° to 180° west from the prime meridian. In giving the coordinates of a place, give latitude first, then longitude; i.e., 29°59′ N, 95°21′ W. Note again in figure 6-5 how this was illustrated.

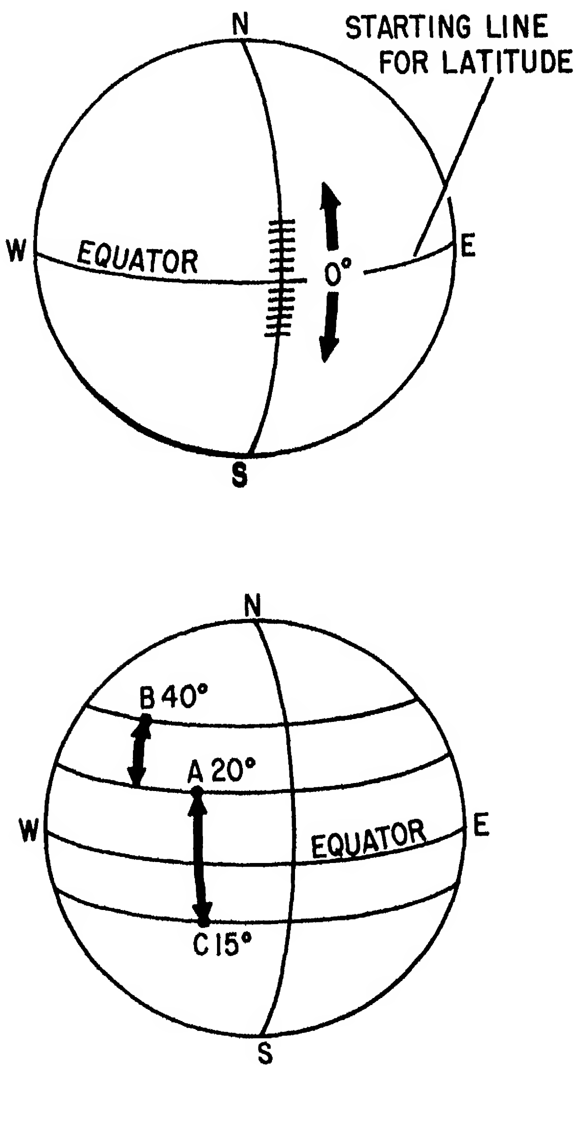

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Figure 6-6.—Difference of latitude.

Each parallel and meridian is named according to its angular distance from the Equator or the prime meridian. Keep in mind, however, that a meridian of longitude is a line; whereas longitude is an angle. Likewise, a parallel of latitude is a line; whereas latitude is an angle.

DL and DLo

The difference of latitude (DL) between two points is the angular distance between the parallels which pass through these points. Thus, it is the arc of any meridian between these parallels. (See figure 6-6.) If both points are on the same side of the Equator, the smaller latitude is subtracted from the larger. Therefore, the DL (difference of latitude) between 20° N at point A and 40° N at point B is 20°. (See figure 6-6.) If the two points are on opposite sides of the Equator, the two latitudes are added. In figure 6-6, the latitude at A is 20° N. If the latitude at C is 15° S, the difference of latitude between A and C is 35°.

Similarly, the difference of longitude (DLo) between any two points is the angular distance between their meridians. (See figure 6-7.) If both points are in east longitude or if both are in west longitude, the smaller longitude is subtracted from the larger. Therefore the DLo between 85° E at point A and 125° E at point B is 40°. If one point is in east longitude and the other in west longitude, the two longitudes are added. If their sum is greater than 180°, it is subtracted from 360°. Thus, the DLo of 125° E at point B and 135° W at point C is 100°.

DIRECTION

To walk across the street to a friend's house, one merely glances at the house and starts walking in that direction. But to fly from Norfolk to Jacksonville, the direction must be obtained in some other manner, usually from a chart. From this example, it can easily be seen that direction is important in navigation, and that some system must be used for expressing the direction from any given point to any other point.

North is the direction of the North Pole from any point on the earth; south is the direction of the South Pole. As one faces north, east is to the

right and west is to the left. These are only four of an infinite number of possible directions. In navigation, the system of designating direction permits a more exact method of locating positions.

Direction is expressed as an angle measured clockwise from north. For example, at any position, imagine a circle whose circumference is divided into 360 equal units. If the divisions are numbered clockwise from north, they indicate true directions from the central or north point. Such a circle could be called a compass rose. The direction of north is 000° or 360°, east is 090°, south is 180°, and west is 270°. In figure 6-8, the direction of B from A is the angle measured clockwise from north to the line AB. (Direction is navigationally defined as a point on the horizon toward which a craft is moving, and it is essentially a line.) Line AB is the angle between the meridian and AB and the direction of B is 045°. Likewise, the direction of C from A is 100° and the direction of D from A is 260°.

It will be helpful to think of directions as angles. Practice estimating the directions of lines by dividing a compass rose into quarters or quadrants, and note which directions fall into each quadrant. Unless there is an arrow, or some device, to show which way a line points, the line has two directions differing by 180°. Later in this chapter, it will be shown why it is important to learn to estimate direction now and avoid making a 180° error. In figure 6-8, the direction of B from A is 045° whereas the direction from B to A is 225°.

Magnetic Compass

As its name implies, the magnetic compass uses the force known as magnetism. The earth has a magnetized core, two magnetic poles, and lines of force that form a magnetic field. Like any other magnet, the earth also has a north magnetic pole and a south magnetic pole. Each is about 1,400 miles away from its corresponding geographic

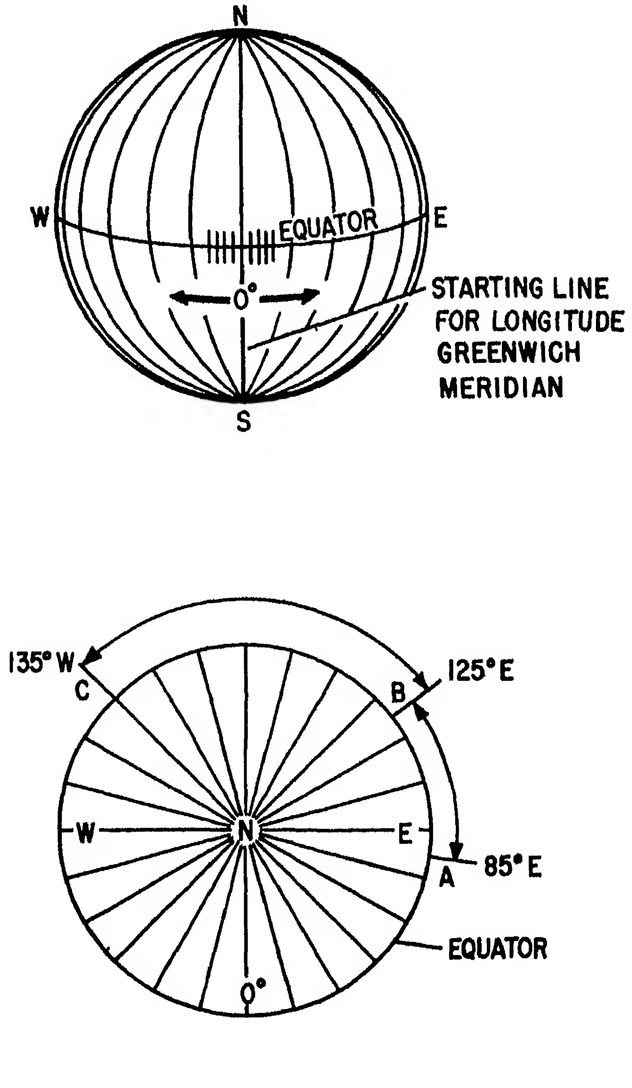

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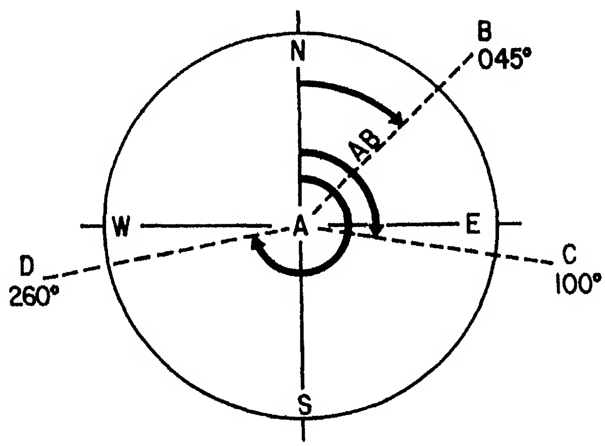
Figure 6-7.—Difference of longitude.



201.78

Figure 6-8.—Direction.

pole. Although they are placed at specific geographic sites on magnetic charts, the locations of the magnetic poles change slightly from time to time.

As in any magnet, lines of force run between the north and south magnetic poles of the earth. Its magnetic field affects any magnetic substance. As a result, a freely suspended magnetic bar or needle will tend to align itself with the earth's lines of force. These lines of force are similar to meridians and are called magnetic meridians.

The magnetic compass is simple in construction. It contains two steel, magnetized needles mounted on a float. A compass card is attached around the float. The needles are parallel with their north-seeking ends pointed in the same direction. The compass card has letters for cardinal headings: (N, E, S, W). Each 30° is represented by a number, from which the last zero is omitted. Between these numbers, the card is graduated for each 5°.

Heading Determined by a Compass

Compasses are used to determine heading, which is the angle measured clockwise from a reference point to the longitudinal axis of the aircraft.

Notice in figure 6-9 that no specific reference point is mentioned. The reference point could be

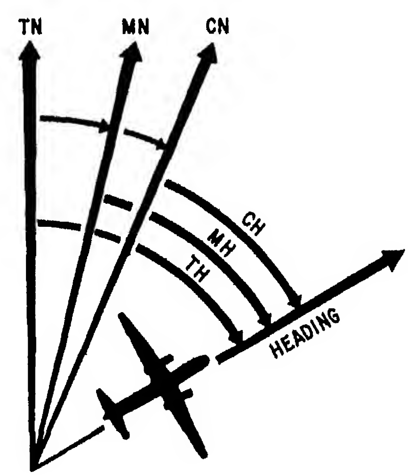


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Figure 6-9.—Reference points in determining headings.

one of several. If the angle is expressed with relation to true north, it is known as TRUE HEADING (TH). If it is measured from magnetic north, it is called MAGNETIC HEADING (MH). Theoretically, it might be measured from compass north; and the term used would be COMPASS HEADING (CH). In each case, the angle is measured in a clockwise direction from the north reference to the longitudinal axis of the aircraft. It is important to determine which reference was used since all of them do not have the same value as shown in figure 6-9. This is done by designating the reference by one of these terms: true, magnetic, or compass.

Variation

When a magnetized needle is influenced by the earth's magnetic field, the direction it points to is magnetic north (MN), and the direction of the north geographic pole is called true north (TN). The angle between magnetic north and true north is termed the variation. Variation differs at different points on the earth. If the needle points to true north, then magnetic north and true north coincide and the variation is zero. When the needle points east of true north, the variation is said to be east; if the needle points west of true north, the variation is called west. (See figure 6-10.)

Note that most charts have information concerning lines of variation. The lines that connect points of equal variation are called isogonic lines. A line which connects points of zero variation is known as an agonic line. Usually, aircraft courses are plotted from a true north reference rather than a magnetic north reference simply because the grid on conventional charts is designed using true north as a reference. As the compass needle is deflected east or west of true north by an angular amount known as variation, a correction must be applied to the true heading in order to obtain magnetic headings. This amount of correction is found on the chart by noting the position of the aircraft in relation to the nearest isogonic line.

Deviation

Variation is caused by magnetic forces outside the aircraft. However, a compass is affected by

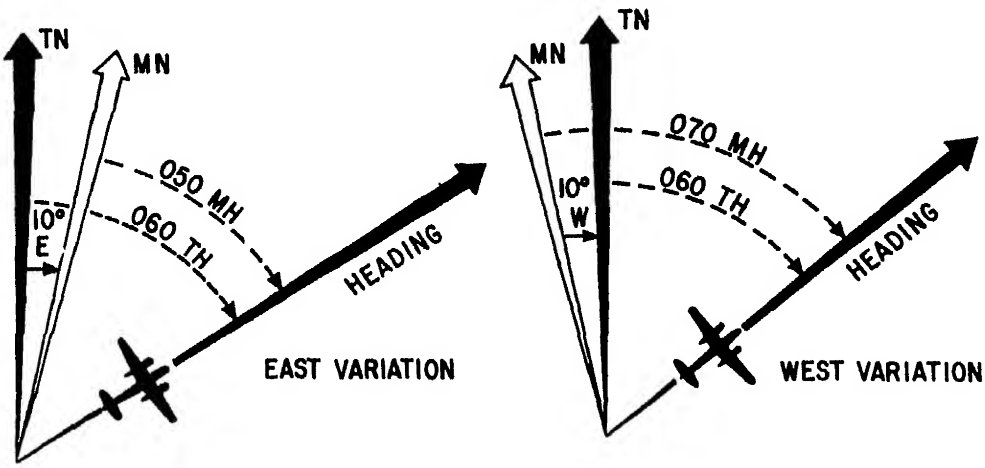

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Figure 6-10.—Angles of variation.

all magnetic fields. A piece of iron close to a compass needle tends to deflect it from magnetic north. Whenever an electric current passes through a wire, a magnetic field is set up around the wire. The combined effect of all the magnetic fields within the aircraft (such as, metal containing iron, operation of electronic or electrical equipment) causes an error in the compass known as deviation.

To understand deviation better, assume that the compass needle always points directly to a nonexistent compass north pole. The direction in which the compass needle points is known as compass north. Compass directions may be expressed relative to compass north just as true directions are expressed relative to true north and magnetic directions are expressed in relation to magnetic north.

Although the compass needle primarily seeks alignment with the earth's magnetic field, deviation will vary as the aircraft changes heading. The metal structure and electrical devices turn with the aircraft, creating a different alignment relationship. As this relationship to the compass needle changes, deviation also changes.

Since deviation may vary with each heading, deviation is determined for each heading that differs by approximately 15° from the previous heading. This is done by a process called swinging the compass. This may be done either in the air or on the ground. The most common method on the ground makes use of a large compass rose (a large concrete area) with magnetic headings inscribed at 15° intervals. Swinging the compass consists of obtaining a compass reading from a known magnetic heading. If the compass reading is greater than the magnetic heading; that is, if the compass reads too high, the deviation is east; and if the compass reads lower than the magnetic heading, the deviation is west. The values of deviation are then recorded on a deviation card and placed in the cockpit of the aircraft.

Applying Variation and Deviation

In navigation it is necessary to be able to change a compass heading to a corresponding true heading, or to start with a true heading and determine the equivalent compass heading. For example, we may start with a compass heading. By applying deviation to this compass heading we obtain the magnetic heading. Variation applied to this magnetic heading gives us the true heading. To help solve a problem of this nature, the following formula is used:

COMPASS ± DEVIATION = MAGNETIC HEADING
MAGNETIC ± VARIATION = TRUE HEADING

In going the other way, the same procedure is followed. If we know the true heading that is to be flown, it is necessary to find the compass

heading to steer in order to maintain this true heading. In this case it is customary to proceed as follows:

TRUE ± VARIATION = MAGNETIC HEADING
MAGNETIC ± DEVIATION = COMPASS HEADING

Sometimes these formulas are summarized by making use of the following memory aid:

Can Dead Men Vote Twice

Reading from left to right we have C D M V T—Compass, Deviation, Magnetic, Variation, True. Reading the other way, from right to left, we have T V M D C—True, Variation, Magnetic, Deviation, Compass.

However, it is impossible to add or subtract a quantity known as east or west. Therefore, it must be given an algebraic sign (plus or minus). To solve for compass heading when true heading is known, a good rule to remember is: east is least, and west is best. This means easterly errors are subtracted and westerly errors are added. When proceeding from compass heading to true heading, the signs are reversed. Figure 6-11 shows this easy method of application.

DISTANCE

Distance, as earlier defined, is measured by the length of a line joining two points. In navigation the most common unit used for measuring distance is the nautical mile. Since miles have various lengths, you should be careful to specify which mile is meant.

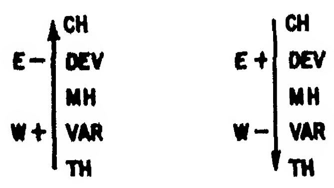

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Figure 6-11.—Application of compass errors.

In the U.S., one mile has been defined by statute to be 1,760 yards or 5,280 feet. This is called a statute mile. Navigators use the nautical mile as a distance unit. The DOD has adopted the international nautical mile which equals 6,076.10 feet.

For most navigation purposes, all of the following units are used interchangeably as the equal of one nautical mile:

1. 1,852 meters (6,076 feet approximately).
2. One minute of arc on the earth's Equator (geographical mile).
3. One minute of arc on a meridian (one minute of latitude).
4. 2,000 yards (for short distances).

Closely related to the concept of distance is speed, which determines the rate of change of position. Speed, in air navigation, is expressed in nautical miles per hour. When the measure of distance is nautical miles, it is customary to speak of speed in terms of knots. Thus, a speed of 200 knots and a speed of 200 nautical miles per hour are the same thing; however, it is incorrect to say "200 knots per hour" unless referring to acceleration.

TIME

One of your earliest experiences in the Navy was that of learning nautical time. This time is expressed in accordance with the approved naval practice—using the 24-hour day with the hours and minutes expressed in a 4-figure group. In working daily as an Air Traffic Controller, a thorough knowledge of time is necessary, particularly in handling communications, processing flight plans, and checking on overdue aircraft.

As seen from the earth, the sun appears to travel across or orbit the earth. The fact that the sun rises in the east and sets in the west seems to prove this. However, the opposite is actually true. The earth orbits the sun, and the earth's rotation on its axis creates the illusion that the sun goes around the earth. This is called the "apparent motion of the sun." Since the sun, for all practical purposes, appears to move from east to west, it

is a good idea to remember that TIME IS ALWAYS LATER TO THE EAST. (See figure 6-12.)

Greenwich Mean Time

For uniformity, the meridian of Greenwich, England has been selected as the prime meridian from which time is measured. You should recall the prime meridian is also the basis for measuring longitude. The moment the sun crosses the meridian, it is noon of that date. Therefore, it can be noon at only one meridian at the same moment. This gives us a common time known as Greenwich Mean Time (GMT) or Greenwich Civil Time (GCT). GMT gives us a reference time to locate time at other points on the earth.

Zone Times and Description

The world is divided into 24 time zones whose central meridians are 0°, 15°, 30°, 45°, etc. All places in any time zone keep the same mean time of the central meridian. Hence, the time can differ only by an integral number of hours from the time at Greenwich.

The local mean time at any one place differs from the mean time at Greenwich by the difference in longitude—one hour for each 15° If local mean time was in common use, there would be a great diversity in the times used at various places. For example, an aircraft flying in an easterly or westerly direction would find that changes in longitude would result in comparable changes in local time.

Late in the 19th century, Congress adopted a uniform system applicable to the Continental United States, establishing four time zones. Each central meridian was designated the standard meridian and its local mean time was designated as standard time within its zone. The U.S. time zones are as follows:

ZONE	CENTRAL MERIDIAN
Eastern standard	75° W
Central standard	90° W
Mountain standard	105° W
Pacific standard	120° W

Boundaries of the standard time zones are somewhat irregular to eliminate inconvenient time changes when traveling. In some cases, cities and states have placed themselves in zones east of the ones in which they would naturally fall.

Generally, in navigation, the standard time zones extend from pole to pole and are exacty 15° wide in longitude. In this system of zone time (ZT) the standard meridian is always the nearest meridian divisible by 15° of longitude. (See figure 6-13.)

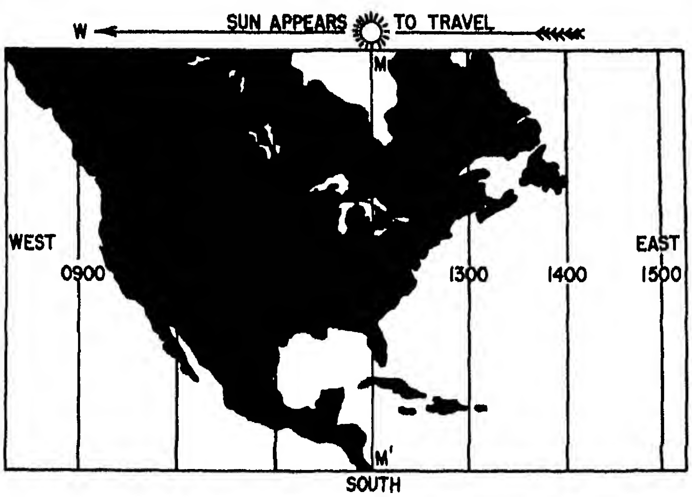

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Figure 6-12.—Noon over a meridian MM

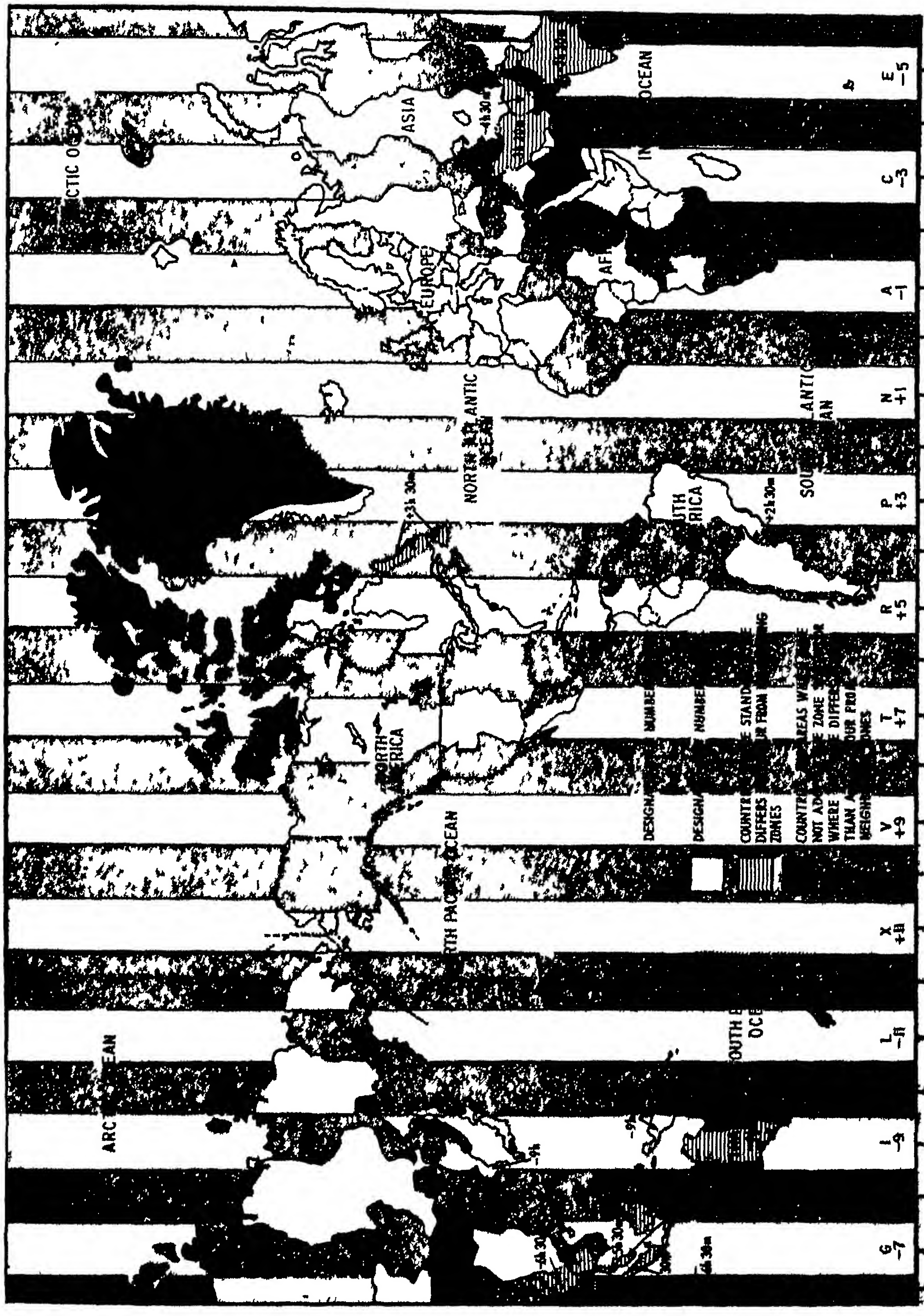

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Figure 6-13.—Standard time zones.

Each time zone is numbered for the multiple of 15° and labeled plus (+) if in the west longitude or minus (−) if in east longitude. Thus, zone +1 extends from pole to pole 7 1/2° on each side of the standard meridian at 15° W, and zone −5 centered on 75° E, extends from 67 1/2° E to 82 1/2° E. The zero zone, centered on Greenwich, extends from 7 1/2° E to 7 1/2° W. The twelfth zone is centered on the 180th meridian, from 172 1/2° W to 172 1/2° E. The half of the twelfth time zone in west longitude is designated +12 and the half in east longitude −12. (See figure 6-13.)

In the zone time system an instant of time is described by the time and the zone description (ZD) or letter suffix (for example, 1745 zone +5 or 1745 R). The limits, description, and letter suffix of each zone are shown in figure 6-13.

For brevity of communication, the zones are sometimes designated by a letter suffix (mentioned in the preceding paragraph) instead of a zone description. Zones in the east longitudes are lettered A through M (omitting J), and zones in the west longitudes are lettered N through Y. The letter Z is reserved for the zero zone, denoting Greenwich time, commonly referred to as ZULU time.

Zone Identification

One of the main advantages of the zone time system in navigation is the ease with which any instant of time can be converted to GMT, or vice versa. In order to find the number for the ZD, you divide any given longitude by 15°. If, when dividing, the remainder exceeds 7°30′ (7 degrees and 30 minutes), add one unit to the answer that you received. For example, let us say that we desire to find the ZD for longitude 143°45′ W. Immediately upon observing that it is a westerly longitude, we find the first component of our ZD to be a plus (east is least, west is best). Then we divide the longitude by 15° to find the zone in which we are located.

$$\begin{array}{r|l} & \underline{\;\;9\;\;\;\;\;\;\;} \\ 15^\circ & 143^\circ 45' \\ & \underline{135\;\;\;\;\;\;\;} \\ & \;\;\;8^\circ 45' \end{array}$$

Since the remainder exceeds 7°30′, add one full unit to the quotient (9), resulting in a ZD of +10, removed in time from Greenwich. Figure 6-13 shows that longitude 143°45′ W has a ZD of +10.

Zone Time, West

In examining figure 6-13, imagine the sun to be over the meridian at 15° W. What time is it in the entire band from 7 1/2° W to 22 1/2° W? By referring to the basic rule we know that it is exactly 1200 in the entire time zone when the sun is over the central meridian for that zone. What time is it now on the Greenwich meridian? It is one hour later, or 1300. Thus, GMT was found by adding the ZD, which obviously represents hours, to the ZT. From this calculation the formula

$$\text{GMT} = \text{ZT} + \text{ZD}$$

is derived, and consequently

$$\text{ZT} = \text{GMT} - \text{ZD}$$

$$\text{GMT} = \text{ZT} + \text{ZD}$$

$$\text{GMT} = 1200 + (+1)$$

$$\text{GMT} = 1300$$

$$\text{ZT} = \text{GMT} - \text{ZD}$$

$$\text{ZT} = 1300 - (+1)$$

$$\text{ZT} = 1200$$

At this point, if you are unfamiliar with the laws governing adding and subtracting signed (positive and negative) numbers, refer to *Basic Mathematics, Volume I,* NAVEDTRA 10069 (Series).

Zone Time, East

To determine times in the eastern longitudes, the same basic procedure and formulas are used. Imagine the sun directly over the meridian at 30° east. What time is it at Greenwich? By referring to figure 6-13 or by dividing the longitude by 15, we know that the time zone or ZD is −2, and 30° east is the central meridian for this zone making

the ZT 1200. Remembering that time is always later to the east and using the formulas we can determine the GMT.

GMT = ZT + ZD

GMT = 1200 + (−2)

GMT = 1000

(*Adding unlike signs indicates subtraction.*)

Time Conversions

Greenwich time provides a standard time to which all other times may be referred. It represents a convenient method of determining times in different zones. For example, assume it is 1500 in a city in zone +5 (ZT_1), on 1 May, and you want to know the time in a city in zone −3 (ZT_2). Use the formulas as follows:

GMT = ZT_1 + ZD_1

GMT = 1500 + (+5)

GMT = 2000

(Adding like signs is simply addition.)

ZT_2 = GMT − ZD_2

ZT_2 = 2000 − (−3)

ZT_2 = 2300

(Subtracting −3 is equivalent to adding +3.)

Frequently time conversion problems involve calculations which result in different dates. To see how this may happen, consider the apparent motion of the sun from 179° east longitude across the face of the chart in figure 6-13 to 179° west longitude. This suggests that exactly at 1200 on the 0° or Greenwich meridian, the date is the same around the world since in ZD − 12, ZT = 2400, and in ZD + 12, ZT = 0000 (ZT = GMT − ZD). This also suggests that each new day begins at the 180° meridian (international date line). Using Greenwich as the reference time to determine ZT in different ZDs, dates should be included in the calculation to maintain the correct day. Look at the following examples:

1. ZT = 0700, 15 June; ZD − 5. What is the correct time in ZD + 4? Solution:

GMT = ZT + ZD

GMT = 0700, 15 June + (−5)

GMT = 0200, 15 June

ZT = GMT − ZD

ZT = 0200, 15 June − (+4)

(At this point we cannot subtract 4 hours from 0200, so we must add 24 hours (one day) to the ZT to permit the mechanical operation of the problem. Since it is always later to the east, the 24 hours we are adding have already elapsed so we must subtract one day from the date.)

ZT = 2600, 14 June − (+4)

or

ZT = 2200, 14 June.

2. ZT = 2100, 31 Aug., ZD + 7. What is the correct time in ZD − 5? Solution:

GMT = ZT + ZD

GMT = 2100, 31 Aug + (+7)

GMT = 2800, 31 Aug.

(Considering again that time is later to the east and the answer exceeds 24 hours, this would indicate that GMT = 0400, 1 Sep. However, it is usually more convenient to wait until the problem is complete to subtract the 24 hours.)

ZT = 2800, 31 Aug. − (−5)

ZT = 3300, 31 Aug.

or,

ZT = 0900, 1 Sep.

Chronometers and Time Signals

Time is determined in the various countries of the world by national observatories such as the U.S. Naval Observatory at Washington and the Royal Observatory at Greenwich. A bureau, coordinated by an international agency, sets up uniform computing procedures, compares time signals, etc.

Accurate time is essential in navigation and air traffic control. Chief among the navigational timepieces is the chronometer. It is a clock of unusually fine construction, designed for extreme accuracy and dependability, and built to withstand shock, vibration, and variations of temperature. Even a chronometer cannot keep exact time indefinitely. The chronometer is checked with a radio signal to determine its accuracy.

Because of their simplicity and accuracy, time signals are transmitted mainly by radio. Naval Observatory time is broadcast in this country by the Naval Radio Station NSS at Washington, D.C., NPG at San Francisco, California, and others. These braodcasts are sent on a continuous wave (CW) so that they can be heard only by receivers suited to code reception. Signals are transmitted during the last 5 minutes of the hour.

Station WWV at Fort Collins, Colo., continuously broadcasts signals based on Naval Observatory time. These broadcasts may be heard with any ordinary radio receiver. Complete schedules and information on Navy time signals can be found in FLIP, Planning, Section III.

ELEMENTARY PLOTTING

From the time an aircraft departs one station until the time it arrives at its destination, the pilot or navigator is very busy. In order to get an aircraft to a given destination and back again, the navigator must keep an accurate account of the aircraft's progress on a chart, plus a complete record or log.

PLOTTING LINES OF POSITION (LOPs)

Suppose, for example, the aircraft is flying over a railroad, but its location along the length of the railroad is not known. If the railroad can be located on the chart, a line of position is established, but not a fix. Then, another railroad that crosses the first is seen. When the second railroad is located on the chart, the exact location of the aircraft along the first railroad is known. Thus, a fix is established. Remember, a fix is an accurate position. Therefore, a fix is determined when the aircraft is over two intersecting LOPs simultaneously.

With chart reading, a fix can often be obtained by finding a specific landmark. However, with other navigation aids, fixes are not obtained directly. Rather, with the exception of radar and TACAN, each fix is established by two or more LOPs which are independently obtained.

It has been seen that a LOP may be a visible line on the ground like a railroad track or another object of known position. However, a LOP is not usually visible until it is drawn on a chart. A radio LOP is obtained by finding the direction of a radio station from the aircraft by means of a radio compass. Having obtained this radio LOP, it is plotted on the chart. Once plotted, it is no different from one obtained by visual reference or by any other aid. LOPs of different types and origins may be crossed to obtain a fix.

LOPs ESTABLISHED BY BEARINGS

A bearing may be measured with reference to true north or with reference to the longitudinal axis of the aircraft; in either case, it is an angle between 0° and 360°.

There is a simple relationship between true heading (TH) of the aircraft, true bearings (TB) of an object, and relative bearing (RB) of an object. True heading is the angle measured from true north clockwise to the longitudinal (fore and aft) axis of the aircraft. Relative bearing is the angle measured from the longitudinal axis of the aircraft, clockwise to a line passing through an object. The sum of these two angles is the angle measured from true north clockwise to the line passing through the object. Therefore, this angle is the true bearing of the object expressed in the following equation:

$$TH + RB = TB$$

Thus, to obtain the true bearing (TB), measure its relative bearing (RB) and add it to the true heading (TH) of the aircraft.

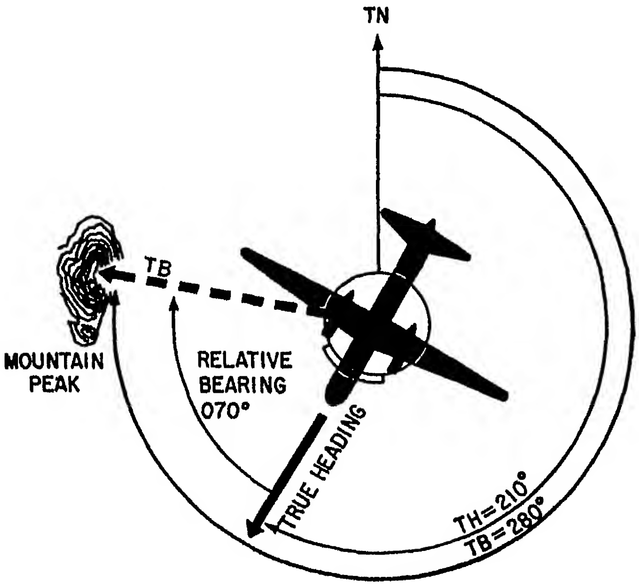

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Figure 6-14.—TH + RB = TB.

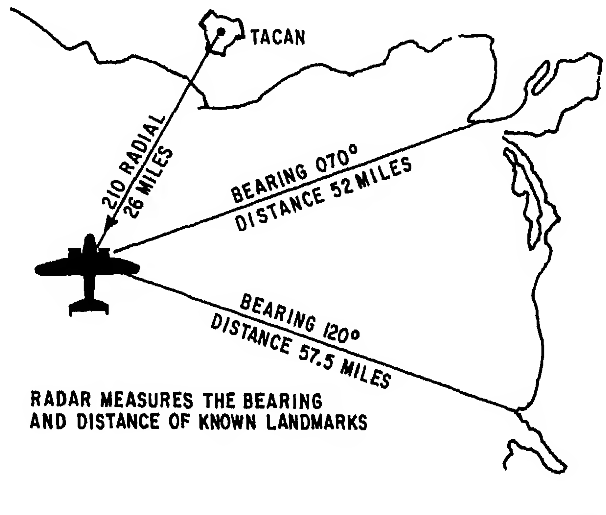

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Figure 6-15.—Positioning by RADAR and TACAN.

As illustrated in figure 6-14, an aircraft is flying a TH of 210°, and a relative bearing of 070° is obtained from a mountain peak. What is the true bearing of the peak? Add TH (210°) to RB (070°) to obtain TB (280°).

By changing the basic formula, you may obtain any one of three components if the other two are known. Thus, to find the true heading, change the formula to read TB − RB = TH. To find relative bearing, change the formula to read TB − TH = RB. Whenever an angle exceeds 360°, subtract 360° to determine the correct bearing.

PLOTTING FROM KNOWN POSITIONS

In plotting LOPs, it is obvious that a plot cannot be made from the aircraft's position as it is unknown. Plot the LOP from the origin, which is a known position. To plot the LOP, use the reciprocal of the true bearing of the object from the aircraft.

When using a plotter to draw a LOP, you need not compute the reciprocal mathematically. Simply align the plotter so that the point of origin lies on the straightedge and the center hole and true bearing (as read on the scale) are over the same meridian. Then draw the LOP toward your position.

Although two intersecting LOPs determine a fix, three intersecting LOPs give a more accurate fix. It is possible to combine a radio LOP with a radar LOP, or a loran LOP with a visual LOP, etc. If three LOPs intersect at one point, use that point for the fix. Usually, however, the errors in obtaining the LOPs and in plotting them will cause the LOPs to form a small triangle for the fix. When this happens, use the center of the triangle.

Positioning by RADAR and TACAN

Airborne radar is oriented so that 360° is represented by the nose of the aircraft. By use of a radar scope in the aircraft, the relative bearing and the distance the aircraft is from known landmarks can be determined, providing a fix. (See figure 6-15.)

TACAN provides bearing and distance information. By use of aircraft instruments, the pilot can determine what TACAN radial the aircraft is on and its distance from the TACAN station. Since the position of the TACAN station is known, a fix, or the aircraft's position, can be determined reltive to the TACAN station. (See figure 6-15.)

EXERCISE

In questions 6-1 through 6-9, listed in column A, choose one or more of the lettered definitions listed in column B.

COLUMN A	COLUMN B
6-1. DLo	a. Defined by stated or implied coordinates
6-2. DL	b. Position of one point in space relative to another without reference to distance
6-3. Distance	c. The spatial separation between two points
6-4. Direction	d. An elapsed interval
6-5. Great Circle	e. The hour of the day
6-6. Latitudes	f. Equator and meridians
6-7. Longitudes	g. Degrees East and West
6-8. Position	h. Degrees North and South
6-9. Time	i. The difference in degrees between two parallels
	j. The difference in degrees between two meridians

6-10. What is the angle between MN and TN called?

6-11. How many magnetic headings are inscribed on a compass rose?

6-12. What two terms are used to describe time as used in air navigation and air traffic control?

6-13. The world is divided into how many time zones?

6-14. If the Central Standard time is 0600, what is the time in ZD 0? Note: Refer to figure 6-13.

6-15. If the true heading of an aircraft is 360° and the true bearing of a mountain peak is 090°, what is the relative bearing of the peak?

6-16. If the true heading of an aircraft is 180° and the relative bearing of a mountain peak is 180°, what is the true bearing of the peak?

AERONAUTICAL CHARTS

Learning Objectives: **Recognize information shown on aeronautical charts and chart source, correction, and procurement procedures.**

From ancient times, man has attempted to reproduce accurately the surface of a sphere on a plane surface. The procedure is similar to that of taking a hollow rubber ball and flattening it; the ball will stretch and split before it will flatten. This is exactly the problem which is encountered in chart construction. As in the case of the rubber ball, when the earth is displayed on a plane surface, some features are distorted and others are lost altogether. Much of the distortion is minimized with the introduction of various mathematical modifications of the geometric map, and the most desirable navigational properties can be accurately or very nearly accurately portrayed.

FACTORS IN CHART CONSTRUCTION

The surface of a sphere or spheroid is said to be undevelopable because no part of it may be spread out flat without distortion. A plane, cylinder, or cone, which can be easily flattened, is called a developable surface. The method of representing all or part of the surface of a sphere or spheroid on a plane surface is called a chart projection.

Geometric projections are actual projections or graticule (lines of latitude and longitude) of the reduced earth onto a developable surface. In theory, a chart could be constructed by placing a light source in a hollow plastic model of the earth with the parallels and meridians inscribed on it, and projecting this graticule on some developable surface. This surface, if it is not a plane, is unrolled to form a flat surface. Any chart that can be constructed in this manner is called a geometric or graphic projection. The appearance and properties of the resultant chart will depend upon two factors: the type of developable surface and the position of the light source within the plastic model of the earth. In actual practice, the projection is constructed mathematically.

Mathematical projections are constructed to provide certain properties which cannot, in theory, be constructed geometrically.

There are many projection methods available for use in chart construction. Each projection has distinctive features which make it preferable for certain uses. No one projection is best for all conditions. Some of the desirable features are:

1. Conformality. Conformality provides that the angle between intersecting curves on the earth will be preserved on the chart. For a chart to be conformal, parallels and meridians must intersect at right angles. In addition, scale or scale expansion must be the same along the meridian as it is along the parallel. Scale on a conformal chart will vary from point to point; however, provided that the variation is the same in all directions, the requirement is met.
2. Constant and correct scale. An ideal model of the earth would have constant and correct scale; i.e., the distance of every place from every other place would bear a constant ratio to the true distance on the earth. Unfortunately, the earth's surface cannot be developed into a plane with stretching or shrinking, which prevents correct and constant scale representation over the entire projection.
3. Correct shape respresentation. To possess the property of correct shape, a chart must be conformal and the scale must be constant and correct in all directions. As pointed out before, this latter prerequisite is not possible to obtain over the entire projection.
4. Straight line. The nature of a straight line on a chart is equally as important as conformality. The rhumb line (a line between any two points which crosses all meridians of the earth at the same oblique angle) and the great circle (defined earlier) are the two curves that a navigator might wish to have represented on a chart as a straight line. The rhumb line is desirable because it is convenient to fly, and the great circle is flown because it provides the shortest path between any two points.
5. Coordinates easy to locate. The geographic latitudes and longitudes of places should be easily found from their positions on the chart. Conversely, positions should be easily plotted on the chart when the latitudes and longitudes are known.

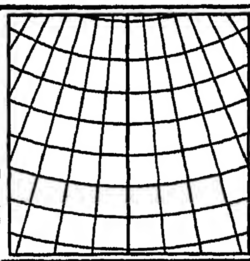
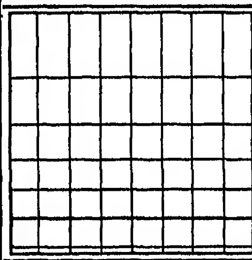
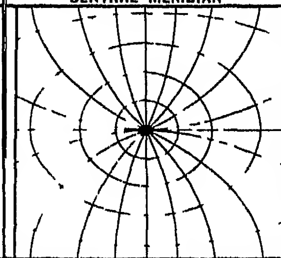
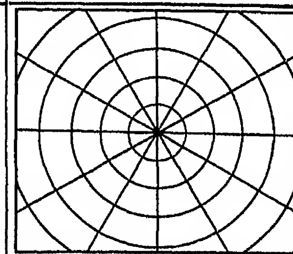
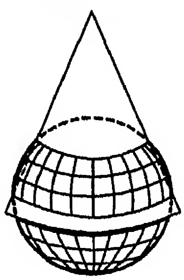
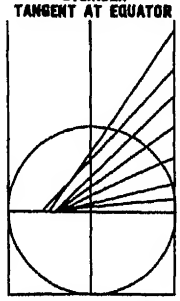
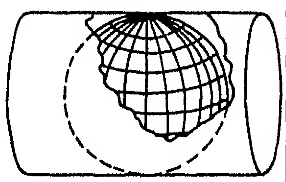
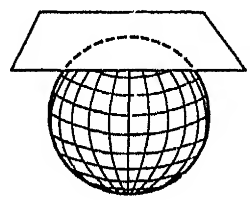
Figure 6-16 shows four types of projections and the basic characteristics of the projections from which the majority of aeronautical charts are constructed.

INFORMATION SHOWN ON AERONAUTICAL CHARTS

An aeronautical chart is a pictorial representation of the earth and its culture. It can provide a picture of any region of the earth.

Several miscellaneous terms frequently utilized in reference to aeronautical charts are defined as follows:

1. Small scale chart. A chart portraying large areas, as the world, a hemisphere, continent, or a country. Usually this is referenced to scales of 1:2,000,000, 1:5,000,000, etc.
2. Medium scale chart. A chart portraying small areas with a relatively large amount of detail, as an area of less than state or county size. Usually this refers to scales of larger than

CHARACTERISTICS	LAMBERT CONFORMAL	MERCATOR	TRANSVERSE MERCATOR	POLAR STEREOGRAPHIC
PARALLELS	ARCS OF CONCENTRIC CIRCLES NEARLY EQUALLY SPACED	PARALLEL STRAIGHT LINES UNEQUALLY SPACED	CURVES CONCAVE TOWARD NEAREST POLE	CONCENTRIC CIRCLES UNEQUALLY SPACED
MERIDIANS	STRAIGHT LINES CONVERGING AT THE POLE	PARALLEL STRAIGHT LINES EQUALLY SPACED	COMPLEX CURVES CONCAVE TOWARD CENTRAL MERIDIAN	STRAIGHT LINES RADIATING FROM THE POLE
APPEARANCE OF GRID				
ANGLE BETWEEN PARALLELS & MERIDIANS	90°	90°	90°	90°
STRAIGHT LINE CROSSES MERIDIANS	VARIABLE ANGLE (APPROXIMATES GREAT CIRCLE)	CONSTANT ANGLE (RHUMB LINE)	VARIABLE ANGLE	VARIABLE ANGLE (APPROXIMATES GREAT CIRCLE)
GREAT CIRCLE	APPROXIMATED BY STRAIGHT LINE	CURVED LINE (EXCEPT EQUATOR AND MERIDIANS)	CURVED LINE	APPROXIMATED BY STRAIGHT LINE
RHUMB LINE	CURVED LINE	STRAIGHT LINE	CURVED LINE	CURVED LINE
DISTANCE SCALE	NEARLY CONSTANT	MID-LATITUDE		NEARLY CONSTANT EXCEPT ON SMALL SCALE CHARTS
GRAPHIC ILLUSTRATION	SECANT CONE 	CYLINDER TANGENT AT EQUATOR  70° 60° 50° 40° 30° 20° 10°		PLANE TANGENT AT POLE 
ORIGIN OF PROJECTORS	CENTER OF SPHERE (FOR ILLUSTRATION ONLY)	CENTER OF SPHERE (FOR ILLUSTRATION ONLY)	CENTER OF SPHERE (FOR ILLUSTRATION ONLY)	OPPOSITE POLE
DISTORTION OF SHAPES & AREAS	VERY LITTLE	INCREASES AWAY FROM EQUATOR	INCREASES AWAY FROM MERIDIAN OF TRUE SCALE	INCREASES AWAY FROM POLE
METHOD OF PRODUCTION	MATHEMATICAL	MATHEMATICAL	MATHEMATICAL	GRAPHIC OR MATHEMATICAL
NAVIGATIONAL USES	PILOTAGE AND RADIO (SUITABLE FOR ALL TYPES)	DEAD RECKONING AND CELESTIAL (SUITABLE FOR ALL TYPES)	GRID NAVIGATION IN POLAR AREAS	POLAR NAVIGATION, ALL TYPES
CONFORMALITY	CONFORMAL	CONFORMAL	CONFORMAL	CONFORMAL

201.94

Figure 6-16.—Chart projections.

1:1,000,000, such as 1:500,000; 1:200,000; or 1:100,000.

3. Graticule. This is the portrayal of meridians on longitude and parallels of latutides.

4. Base detail. This includes all features portrayed on a chart other than those on the aeronautical or grid overprint. It includes relief, culture, hydrography and vegetation.

5. Contours. A contour is represented by a line on a chart connecting all points of a given elevation above sea level. The shoreline of an ocean may be considered as the mean zero-foot contour. On a steep slope contours are close together; on a gentle slope they are farther apart.

6. Gradient tints. This means different colors used to depict intervals between certain contour lines.

7. Spot elevations. A dot with an elevation value depicts an accurately measured elevation above sea level at a specific location. On some charts a small "x" is used to indicate an approximate elevation at a specific location. If the exact location of an elevation is unknown, only the figures are shown.

8. Water tint. This depicts open water areas such as oceans and lakes by a solid tint, usually a light blue.

9. Water vignette. This is an alternate treatment of open water where the water is depicted with a deep or dark tone along the shoreline and rapidly but evenly lightened in tone with progression outward from the shore to a blank or white portrayal. This technique makes a chart with large white open water areas easier to plot on, and accentuates small bodies of water and small islands.

10. Land tint. Land tint is a solid tint over all land area with no gradient tints and often no contours.

11. Relief. This refers to physical features related to the relative differences in elevation of the land surface. It includes features such as mountains, hills, plateaus, plains, depressions, etc. The complexity of relief features is dependent upon scale and/or contour interval used. Generally large scale charts show many relief features, whereas very small scale charts can only show major mountain masses.

12. Culture. Culture includes populated places, roads, railroads, installations, miscellaneous construction, such as dams, bridges, and mines. Standard symbols are used. Density of portrayal is related to chart scale, chart use, and the geographic area covered.

13. Hydrography. Hydrography includes coast lines, oceans, lakes, rivers and streams, canals, swamps, reefs, etc. Density is indicated by reference to the principal or detailed drainage. Open water may be portrayed by water tint or vignette, or may be left blank.

14. Vegetation. This is not shown on most small scale charts. Forests and wooded areas in certain parts of the world are shown on some medium scale charts. Additionally, some medium scale charts have park areas, orchards, hedgerows, and vineyards.

SOURCES OF AERONATUICAL PRODUCTS

The importance of the availability of up-to-date Aeronautical Charts and Flight Information Publications (FLIPs) at ATC facilities must be emphasized. Outdated or incorrect charts and publications have been the source of countless aircraft accidents and incidents. ACs are required to possess a thorough knowledge of the procurement and maintenance of those charts and publications required at their facilities. It is realized that the responsibility for this function is normally assigned to the Flight Planning Branch Manager, but it remains incumbent upon all personnel assigned to this branch to become proficient in this vital area of flight safety.

GENERAL

The Defense Mapping Agency (DMA) is responsible for production or procurement, inventory management, and distribution of navigational and intelligence material to meet the Navy's operational requirements. The DMA Office of Distribution Services (DMAODS), Washington, D.C. has established an Automated Distribution Management System (DADMS). This system uses several strategically located DMA Distribution Control Points (DDCP) for the distribution of all DMA products.

The DMA Distribution Control Point (DDCP), Washington, D.C., is the continental United States (CONUS) activity designated to receive and process requisitions for aeronautical charts, FAA publications, and related products. Requisitions processed by the DDCP Washington, D.C. are filled by DDCPs at Philadelphia, Pennsylvania and Clearfield, Utah. The DMA Aerospace Center (DMAAC/GADF), St. Louis Air Force Station, Missouri, is the CONUS activity designated to receive and process requisitions for FLIPs and related products. Activities outside CONUS may requisition aeronautical material from strategically located DMA overseas depots or service depots.

Fleet activities normally submit requisitions to the DDCP Washington, D.C.; however, they may use overseas depots as appropriate while operating in areas adjacent to these distribution activites. Activities having immediate operational requirements may obtain over-the-counter issue from the nearest DMA activity.

The DMA Catalog of Maps, Charts, and Related Products, Part 1, Volume 1 provides information on the availability, sources of supply, and requisitioning procedures for all aeronautical charts, special purpose charts, FLIPs, and related products available. The catalog is a looseleaf type publication containing several sections, each describing the availability of a specific product and procurement procedures. For example, Sections IV and V list the FLIPs and related products that are available. The catalog is kept current by semiannual publication of a new catalog or replacement pages containing changes or additions. All of the products listed in this catalog are available for automatic distribution upon request to DDCP or DMAAC as appropriate.

CHART UPDATING INFORMATION

Updating information on aeronautical charts listed in the DMA Catalog is provided to DOD users in the following publications:

1. The DMA Aeronautical Chart Bulletin Digest is published semiannually. It provides a listing of current chart editions of all charts shown graphically in the catalog. It informs users of new editions of charts and publications, information on replacement charts, and notices pertaining to supply.
2. The DMA Aeronautical Chart Bulletin is published monthly. It lists new charts and editions which were issued after the Digest was published.
3. The DMA Aeronautical Chart Updating Manual (CHUM) is published semiannually. It furnishes information on significant chart changes and corrections.
4. The DMA Aeronautical Chart Updating Manual Supplement (CHUM Supplement) is published monthly between issues of the CHUM. It contains a listing of supplemental corrections.

The semiannual CHUM contains all the updated information from the previous CHUM and CHUM supplements, and the previous editions may be discarded. Additionally, each CHUM Supplement supersedes the previous CHUM Supplement.

The semiannual Aeronautical Chart Bulletin Digest contains all the updated information from the previous Bulletin Digest/monthly Bulletins, and previous editions may be discarded. The monthly Bulletins are a cumulative system and should be retained until the issuance of a new Bulletin Digest.

To update a chart, use the following procedures:

1. Consult the latest Bulletin Digest and subsequent monthly Bulletins to verify that the chart is current. If either of these publications lists a higher edition number or a later air information date, the chart is not current and SHOULD NOT BE USED.
2. Consult all sections of the CHUM, CHUM Supplement, and FLIPs—particularly for information on Air Defense Identification Zones (ADIZs), special use airspace, and obstructions near airfields; also consult Notice to Airmen (NOTAMs). You should then apply appropriate corrective information to the chart before it is used.

REQUISITIONING

In both general use and training, the Flight Planning Supervisor should follow authorized requisitioning procedures. Section II of the

DMA Catalog contains complete information necessary to order aeronautical charts and publications. The following forms may be used for requisitioning:

1. DD Form 1348m—DOD Single Line Item Requisition System Document (Mechanical)

2. DD Form 1348—DOD Single Line Item Requisition System Document (Manual)

3. SF 344—Multiuse Standard Requisitioning/ Issue Document

4. DD Form 173—Joint Message Form Requisition

Activities having punch card facilities should submit the DD Form 1348m to the designated source of supply. Those activities having transciever facilities may transceive the DD Form 1348m via the Automatic Digital Network (AUTODIN). The DD Form 1348m card form may be mailed if AUTODIN is not readily available. Figure 6-17 is an example of a completed DD Form 1348m.

Those activities that do not have punch card equipment or transceiver facilities may use DD Form 1348 or SF 344. These forms should be mailed to the designated supply source and identified by inserting the word "MILSTRIP" in the lower left corner of the envelope. MILSTRIP is the contraction for Military Standard Requisition and Issue Procedures. See figures 6-18 and 6-19 for examples of these completed forms. To requisition items not identified in the DMA catalog or items where the stock number is not known, the SF 344 is used. When used in this manner, the item description may be written across the entire line under requisition data without regard to columnar headings. Such data as the quantity, serial number, supplementary address, and signal and advice codes are entered directly below the item description in the appropriate blocks.

Message requisitions are acceptable provided they are in the format shown in the catalog (see figure 6-20). The term "MILSTRIP REQUISITION" should precede the text of the message.

Telephone requests are acceptable when the urgency of the requirement dictates.

The coding structure for all the requisition forms is the same. Section II of the DMA Catalog gives a working example and discussion of coding instructions.

AUTOMATIC INITIAL DISTRIBUTION (AID)

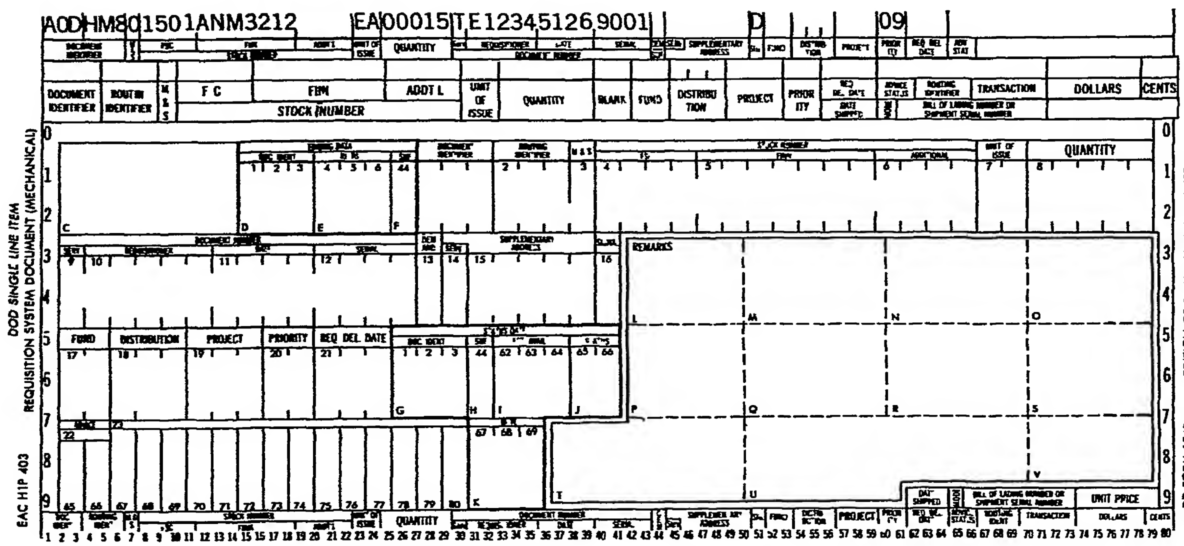
The DMA definition for automatic initial distribution is, "the predetermined distribution of charts or other products which is accomplished immediately upon completion (reproduction) of the product." Activities wishing to receive automatic initial distribution of DMA aeronautical products should forward their request to DDCP or DMAAC as appropriate. The request may be made by letter or on one of the forms previously discussed. The basic concept behind automatic distribution is the automatic (recurring) provision of Flight Information Publications and Navigation/Planning chart products to units based on their preestablished requirements. Users are expected to monitor requirements continually and effect reductions whenever possible.

Each user is provided with computer listings of their automatic distribution requirements. A survey of each unit's automatic distribution requirements is conducted annually by both DMAAC and DMAODS.

CIVIL EDITIONS OF DOMESTIC AERONAUTICAL CHARTS

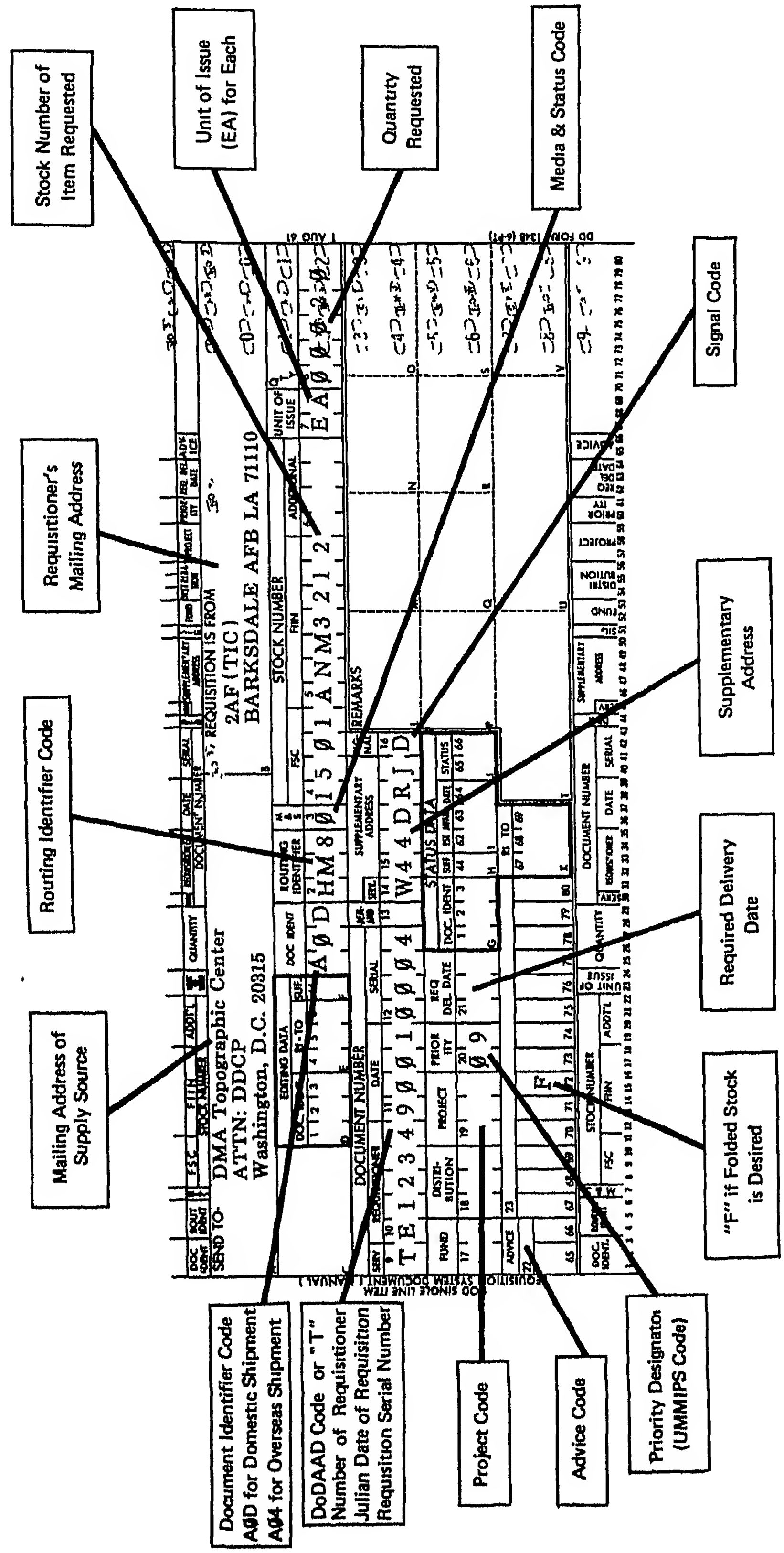
U.S. Navy requirements for Sectional Charts and VFR Terminal Area Charts are extremely limited. Tactical Pilotage Charts (TPC) satisfy most USN requirements and should be used when applicable. Originating activities of a published VFR Low Altitude High Speed Route are authorized a minimum number of Sectional Charts (Five) for coordination with the Federal Aviation Administration (FAA). All other USN units having a valid need for Sectional Charts and the associated VFR Terminal Area Charts must submit requests with justification through their major command headquarters to DMAODS/ DDCP.

CARD COLUMN	EXPLANATION
1–3	Document Identifier Code A04 – oconus shipment A0D–CONUS shipment
4–6	Routing Identifier Code (Supply Source)
7	Media & Status Code
8—22	Stock Number
23—24	Unit of Issue—EA
25—29	Quantity Requested (fill all columns)
30—35	DoDAAD Code or "T" number of Requisitioner
36—39	Julian Date of Requisition (year & day—fill all columns)
40—43	Requisition Serial Number (fill all columns)
44	Leave blank
45—50	Supplementary Address
51	Signal Code
52—53	Leave blank
54—56	Leave blank
57—59	Project Code (optional)
60—61	Priority Designator (UMMIPS Code)
62—64	Required Delivery Date (optional)
65—66	Advice Code
67—71	Leave blank
72	"F" if folded stock preferred
73—80	Leave blank



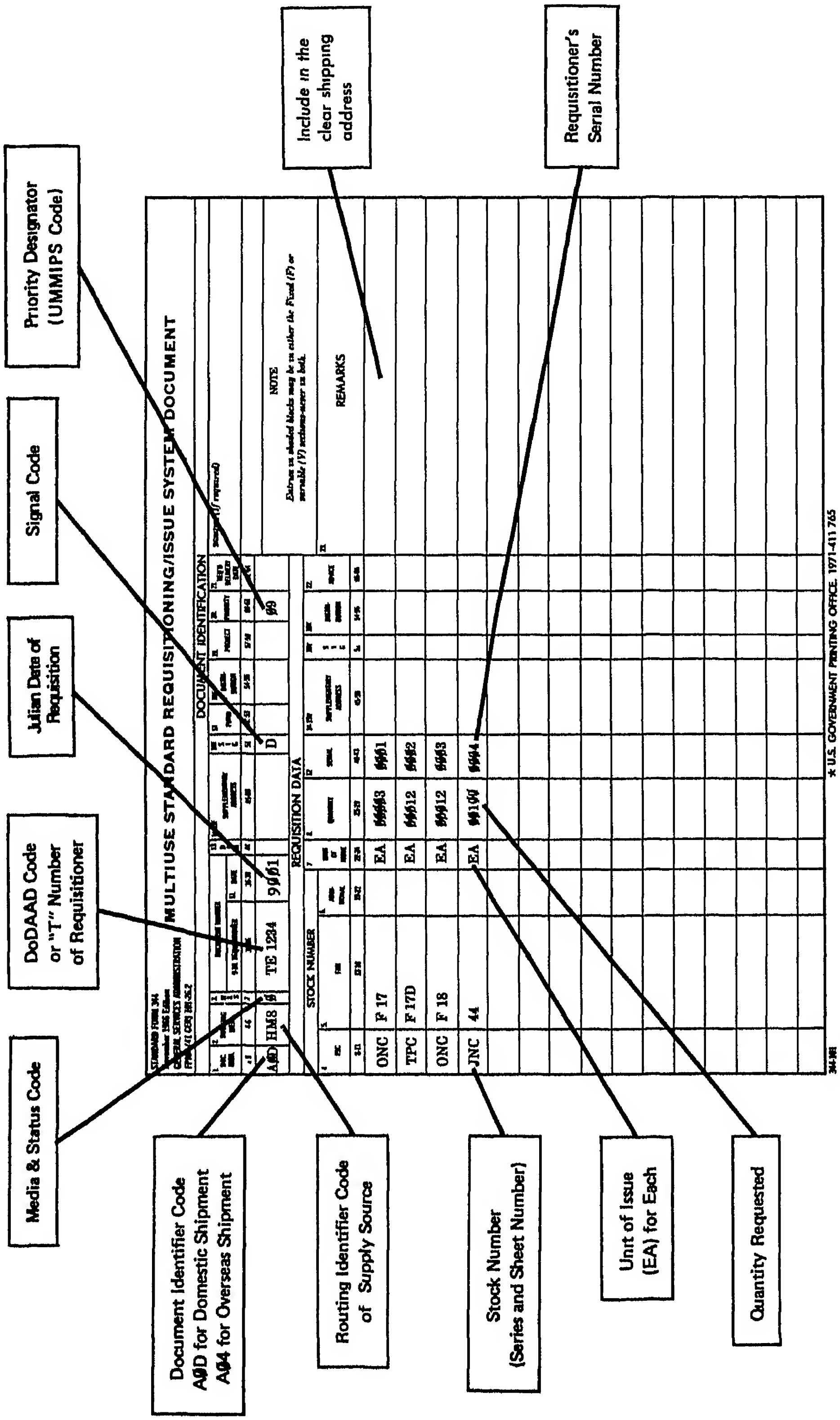
202.44

Figure 6-17.—DD Form 1348m.



202.45

Figure 6-18.—DD Form 1348.



202.46

Figure 6-19.—Standard Form 344.

JOINT MESSAGEFORM

SECURITY CLASSIFICATION

PAGE OF	DRAFTER OR RELEASER TIME	PRECEDENCE ACT	PRECEDENCE INFO	LMF	CLASS	CIC	FOR MESSAGE CENTER/COMMUNICATIONS CENTER ONLY	DATE TIME	MONTH	YR

BOOK

MESSAGE HANDLING INSTRUCTIONS

FROM: 2AF(TIC) BARKSDALE AFB LA//

TO: DMATC WASH DC //DDCP//

MILSTRIP REQUISITIONS

1 A0D/HM8/0/ONCXXF17/EA/00001/TE1134/9ØØ1/0120/BLNK/BLNK/D/ BLNK/BLNK/BLNK/05/008/2B/BLNK/BLNK

2 A0D/HM8/0/TPCXXF17D/EA/00001/TE1234/6001/0121/BLNK/BLNK/D/ BLNK/BLNK/BLNK/05/008/2B/BLNK/BLNK

≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡≡

1 This is a sample of a multirequisition message requesting one each of two items. Following is an explanation of the first item

AØD/	document identifier code
HM8/	routing identifier code
Ø/	media and status code
ONCXXF17/	stock number
EA/	unit of issue
ØØØØ1/	quantity
TE1234/	DoDAAD code or "T" number of requisitioner
9ØØ1/	date of requisition
Ø12Ø/	requisition serial number
BLNK	
BLNK	supplementary address
D/	signal code
BLNK/	fund code
BLNK	distribution code
BLNK	project code
Ø5/	priority designator
ØØ8/	required delivery date
2B/	advice code
BLNK	
BLNK	

2 All elements of data must be included for each succeeding item requested

3 When an element of data is not applicable, the field will be recognized and entered as BLNK/

DISTR:

DRAFTER TYPED NAME, TITLE OFFICE SYMBOL, PHONE & DATE

SPECIAL INSTRUCTIONS

RELEASER

TYPED NAME, TITLE, OFFICE SYMBOL AND PHONE

SIGNATURE

SECURITY CLASSIFICATION

DD FORM 1 DEC 70 173 REPLACES PREVIOUS EDITION WHICH WILL BE USED.

202.47

Figure 6-20.—Message requisition.

There is no Department of Defense (DOD) requirement for civil editions of domestic World Aeronautical Charts (WAC). Past requirements are being met by use of Operational Navigation Charts (ONC).

FAA PUBLICATIONS

The DMAODS/DDCP distributes FAA publication to all DOD activities through the DMA Automated Distribution Management System (DADMS). The basis of distribution is in accordance with a listing in Section I of the catalog. The publications are distributed to USN ground activities involved in air traffic control procedures on an "as required" basis. Requisitioning forms and procedures are shown in Section II of the catalog and automatic distribution is available. A request for more than one copy of a publication requires justification, such as training.

FLIGHT INFORMATION PUBLICATIONS (FLIP) PROGRAM

This worldwide program was designed using the concept that there are basically three separate phases of flight—flight planning, en route operations, and terminal operations. FLIPs are published by either the DMAAC or by National Ocean Survey (NOS). FLIPs are distributed by the DMAAC. No one document contains all the information which may be required for a flight. FLIP Planning, planning charts, en route charts and supplements, instrument approach procedures, and NOTAM files must be consulted prior to flight. In planning for international flights, reference must also be made to the Foreign Clearance Guide. This section contains a general outline and description of each U.S. publication included in the FLIP program.

FLIP Planning

FLIP Planning is intended primarily for use in the Flight Planning Branch Office. It is functionally arranged into two parts: General Planning (GP) and Area Planning (AP).

The General Planning Book contains general information on Flight Plans and Pilot Procedures that have common worldwide application plus information pertaining to ICAO procedures.

The Area Planning Books contain planning and procedural data for specific geographical areas of the world. Essentially these books include those theatre, regional and national procedures which differ from the standard procedures adopted within ICAO.

The General Planning and Area Planning Books are divided into chapters or sections. Pages and major paragraphs are numbered accordingly to provide an easier reference when using the Table of Contents. Special Notices are printed on the inside front cover of each publication.

A complete FLIP Planning for the entire area of coverage is comprised of sections as listed below. An area of coverage chart is on the back cover of all planning documents with the exception of AP/1B, Military Training Routes—North and South America. Separate divider cards are provided for convenience in filing and in use of amendments.

GENERAL PLANNING.—Published every 32 weeks, this section contains general information on all FLIPs, explanation of the Division of Airspace, flight plans and codes, common worldwide pilot procedures, ICAO procedures, meteorological data, time signal information, terms and abbreviations and worldwide conversion tables.

AREA PLANNING (AP/1, 2, and 3).—Published every 16 weeks, these sections contain planning and procedures information for a specific geographic area.

AREA PLANNING (AP/1A, 2A, and 3A) (SPECIAL USE AIRCRAFT).—Contains a tabulation of all prohibited, restricted, danger, warning and alert areas, intensive student jet training areas, military training areas, and known parachute jumping areas. This section is published every 16 weeks.

AREA PLANNING (AP/1B) (MILITARY TRAINING ROUTES, NORTH AND SOUTH AMERICA).—Published every 8 weeks, it contains information relative to military training routes, including Olive Branch Routes, VFR Low Altitude High Speed Training Routes (LAHSTR)

and refueling tracks and areas. Charts (6 charts on 3 sheets) containing graphic descriptions of the LAHSTR System throughout the United States are also included.

PLANNING CHANGE NOTICE (PCN).—FLIP Planning is updated by scheduled PCNs or replacement pages. PCNs should be filed in front of the appropriate FLIP Planning after annotating the affected paragraph with a reference to the PCN. (For example, see PCN, dated 18 August 1975).

FLIP, Planning Chart—Low Altitude—U.S.

The IFR Wall Planning Chart consists of two sheets. It covers East and West U.S. and contains required information for preliminary flight planning. The information shown on this chart portrays radio aids to navigation for high and low altitude airways, authorized acrodomes, and other areonautical data necessary for flight planning. It is issued every 16 weeks.

There are also FLIP Planning Charts for both low and high altitude available for Europe and North Africa.

En Route and Terminal Publications

FLIP en route and terminal publications are designed to provide airway structure, radio navigation, letdown, approach, and landing information for use during the in-flight phase of IFR operations. The DOD FLIP Enroute Supplements (IFR and VFR) support these publications with supplemental aerodrome, facility, communication, and procedural information. Enroute and terminal publications are available for all areas of the world, but only those applicable to the U.S. are discussed here. You should refer to FLIP General Planning Section I, or the publications themselves, for more detailed information.

STANDARD INSTRUMENT DEPARTURES (SID).—SID charts are published either as individual charts or as a bound booklet containing departure air traffic control instruction in a pictorial form, for departure from an individual aerodrome.

FLIP ENROUTE LOW ALTITUDE—U.S.—These charts portray the airway system and related data required for IFR operation at altitudes below 18,000 MSL. Twenty-six variable scale charts are printed on 13 sheets, L-1 through L-26, covering the entire U.S. An additional sheet, containing charts L-27 and L-28, which duplicate data shown on L-20, L-22, L-24, and L-25, is available for those who frequently plan flights north and south along the east coast within the area of coverage. (See figure 6-21.) In addition, another sheet printed on both sides shows twelve highly congested areas. This area chart is designated A-1 and A-2.

The effective date and the expiration date are shown on the cover of each item. Major changes to the airway structure and procedures are scheduled by the FAA to become effective on a specific date. Charts are revised every eight weeks and show the date this information is effective. Charts, therefore, should not be used prior to the effective date. Other information, such as frequencies, hours of operation, etc., is not scheduled and changes occur daily. Action is taken to update this data during the revision cycle; however, NOTAMs must be consulted for the latest information on data changing after the cutoff date and during the life of the current charts.

FLIP ENROUTE HIGH ALTITUDE—U.S.—These charts portray the jet route system and related data required for IFR operations at and above flight level 180. Four constant scale charts are printed on two sheets. These charts may be assembled to form a wall planning chart for high altitude, and are also issued every eight weeks. (See figure 6-22.)

FLIP ENROUTE IFR SUPPLEMENT—U.S.—This supplement is a bound booklet containing an alphabetical listing of all IFR aerodromes/facility directory integrated with an alphabetical listing of all NAVAIDs and ARTCC facilities. Also published are brief presentations of such items as ADIZ, procedures, position reporting, and other information. The IFR Supplement is published every eight weeks.

FLIP ENROUTE VFR SUPPLEMENT—U.S.—This supplement is a bound booklet

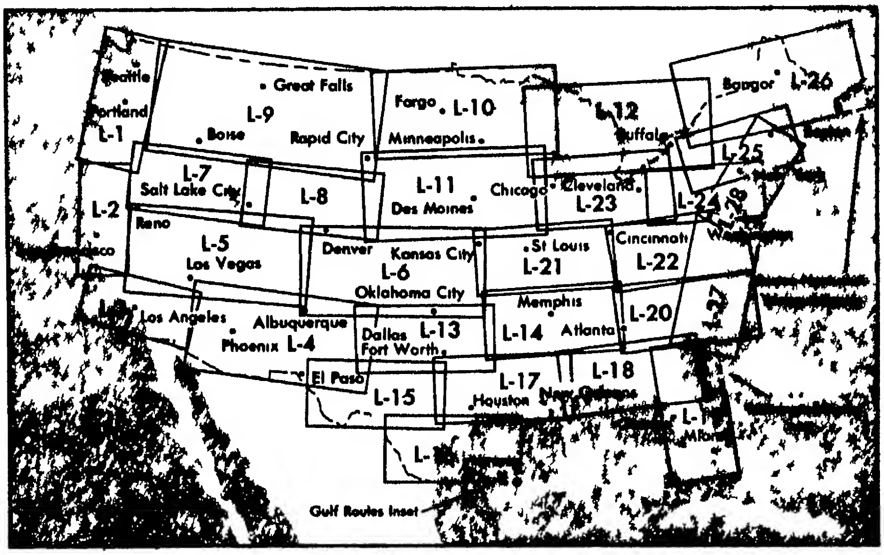


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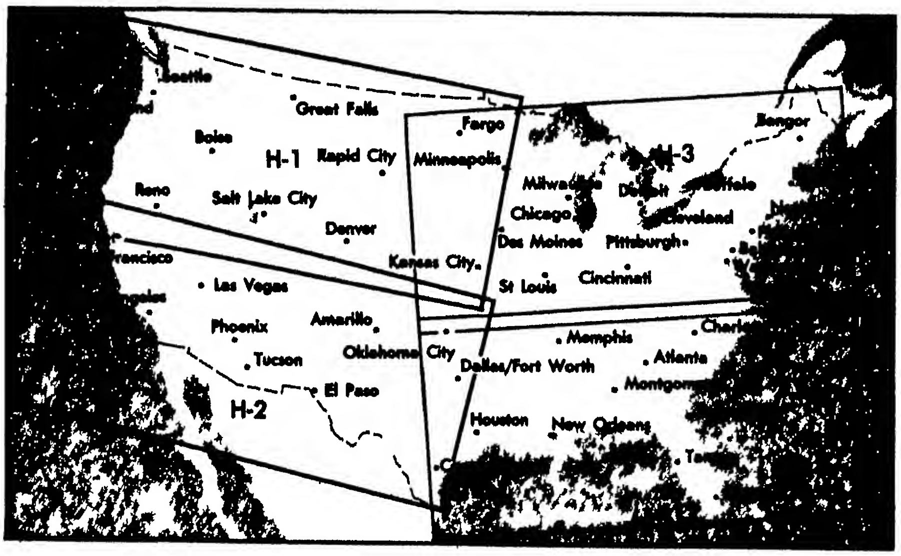
Figure 6-21.—FLIP enroute low altitude, U.S.



201.253

Figure 6-22.—FLIP enroute high altitude, U.S.

containing an alphabetical listing of selected VFR aerodromes and cross-references to IFR aerodromes as published in the IFR supplement. Also included are city/aerodrome cross-reference listings, VFR special notices, and aerodrome sketches arranged in alphabetical order by aerodrome name. These sketches are designed as a visual aid to visual identification of aerodromes. This supplement is published every 24 weeks.

FLIGHT INFORMATION HANDBOOK.—This Handbook is a DOD Flight Information Publication (FLIP) issued every six months. The Flight Information Handbook contains aeronautical information which is required by DOD aircrews in flight, but which is not subject to frequent change. Sections include Emergency Procedures, National and International Flight Data and Procedures, Meteorological Information, Conversion Tables, and Standard Time Signals. This publication is intended for U.S. military use, and procedures herein may not be applicable to other users.

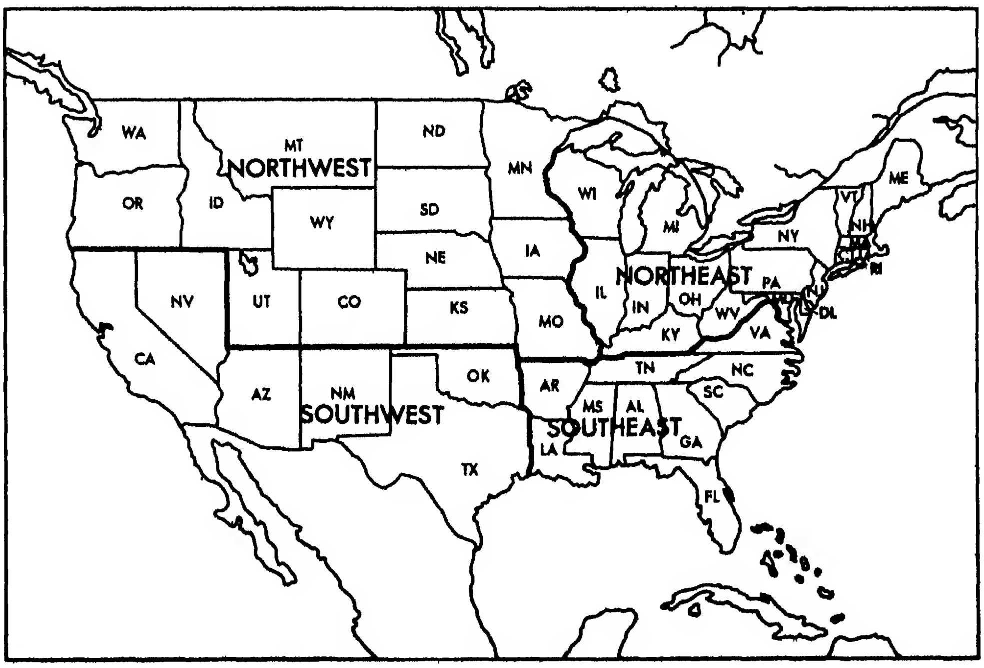
FLIP TERMINAL HIGH ALTITUDE—U.S.—These publications consist of four bound booklets, each covering a certain geographic area of the U.S. (See figure 6-23.)

They contain high-altitude instrument approach procedures and radar minimums combined with an aerodrome sketch with additional data as deemed necessary for an approach under IFR conditions.

Transitional information from the jet route structure to the terminal facility has been added to charts covering the U.S.

The FLIP Terminal High Altitude—U.S. booklets are published every 8 weeks. Their effective dates are printed on the front cover. When amendments or changes are required between issues, they are issued by NOTAMs or by Military Aviation Notices (MANs).

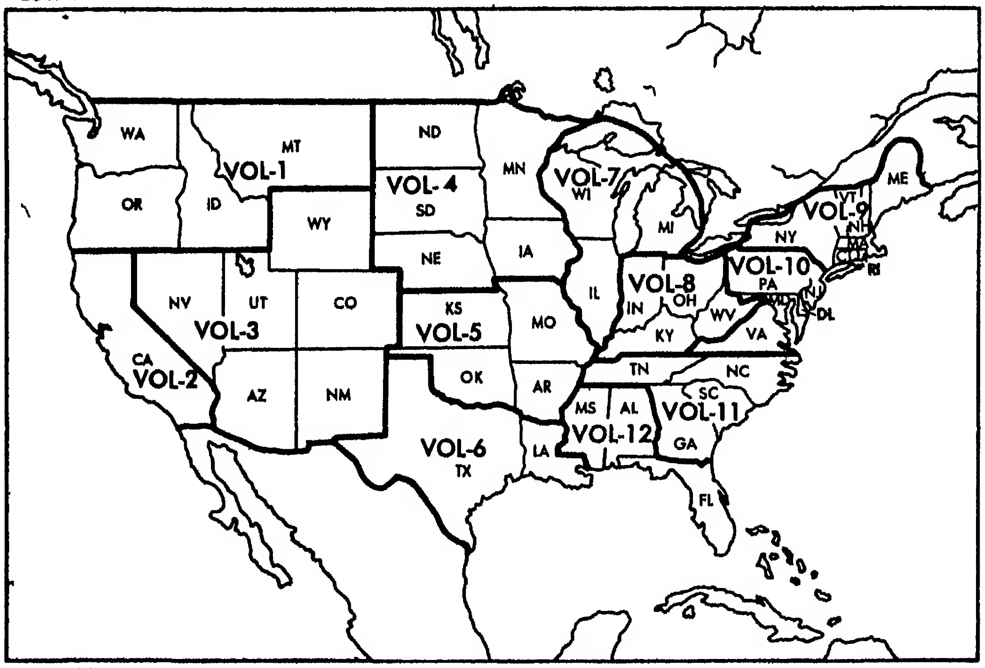
FLIP TERMINAL LOW ALTITUDE—U.S.—There are two editions or sets of this publication: one consists of nine bound booklets numbered 1 through 9, the other consists of five bound booklets lettered A through E. Each booklet covers a certain geographical area (see figure 6-24). The nine-volume set contains all DOD instrument approach procedures, airfield diagrams, radar instrument approach minimums, their civil procedures, diagrams, and minimums requested by the Military Departments. The five volume set called FLIP Terminal Selected Low Altitude—U.S. contains the same information, but only for those airfields with a runway



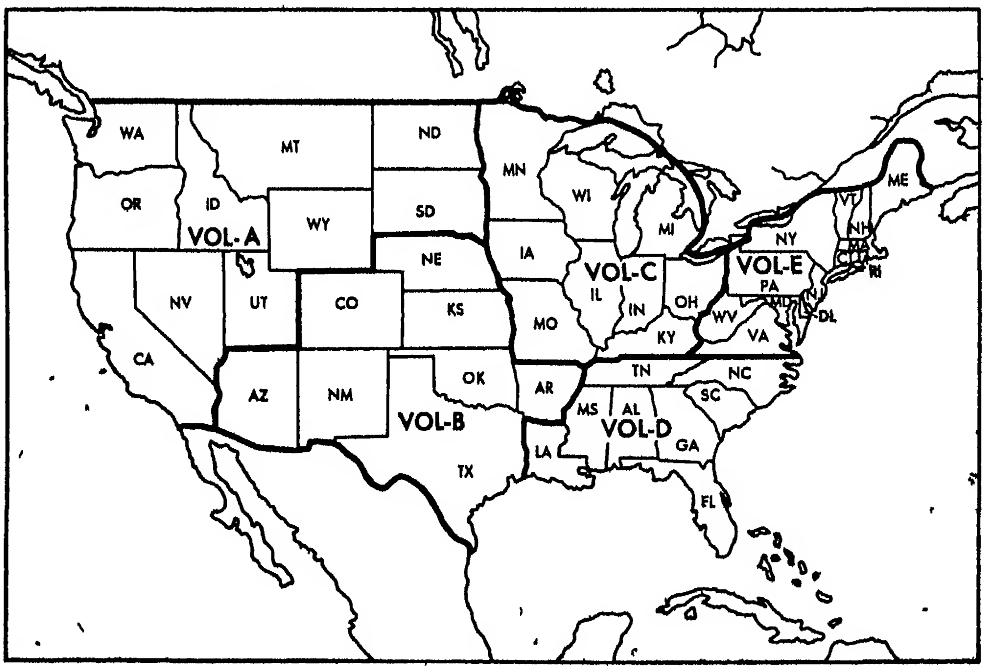
201.254

Figure 6-23.—FLIP terminal high altitude, U.S.

Low Altitude-12 Volumes



Low Altitude-5 Volumes



201.255

Figure 6-24.—FLIP terminal low altitude, U.S.

h of 5000 feet or greater and a weight bearing :ity of 60,000 pounds or greater.

oth Terminal Low Altitude—U.S. sets are shed every eight weeks and are amended by ary Aviation Notices (MANs) which are d booklets issued at the four week midpoint.

CELLANEOUS FLIGHT)RMATION PRODUCTS

ign Clearance Guide

'he Foreign Clearance Guide is a group of ıd booklets, including a general information ial publication for disseminating USAF ldwide foreign clearance requirements and ·mation of personnel travel; aircraft ement to, from, and between foreign areas; ransport of material aboard aircraft. It is also by the Navy and Army. Revised area lets and general information sections are d on a semiannual and/or quarterly basis. Foreign Clearance Guide Change Notices :N) are issued monthly. These notices contain ımulative listing of all permanent and ·oı ary changes not yet incorporated in the lets. A classified supplement is issued terly. Teletype Interim Changes Notices [) are dispatched as required to selected essees who require immediate notification of ges to the Guide.

. Airman's Information Manual

'he Airman's Information Manual has been ;ned as a pilot's operational manual for use arily within the conterminous United States. uch, it is comparable to the DOD FLIP ning and Enroute IFR and VFR Supplements ications.

'ou should be familiar with this manual for y reference when assisting pilots. It contains alth of data related to ATC functions.

Jse of the AIM is part of the practical test obtaining a Control Tower Operators ificate (CTO) in accordance with FAR Part 'he manual is divided into three components (issued separately), each of which is described in the following paragraphs.

BASIC FLIGHT INFORMATION AND ATC PROCEDURES.—contains instructional information of a relatively permanent nature; i.e., description of various navigation aids with proper use procedure, procedures for obtaining weather and preflight and inflight services, arrival/departure and enroute procedures plus emergency procedures and a Glossary of Aeronautical Terms. This component is revised semi-annually.

NOTICES TO AIRMEN.—a cumulative publication containing selected permanent and short duration NOTAMs considered essential to flight safety. It is revised every 14 days.

GRAPHIC NOTICES AND SUPPLEMENTAL DATA.—contains a tabulation of Parachute Jumping Areas; Military Training Routes and Aerial Refueling Tracks; Olive Branch Routes; Terminal Area Graphic Notices and Terminal Radar Service Areas. This component is revised quarterly.

EXERCISE

In answering questions 6-17 through 6-19, select from column B the correct projection questioned in column A. Refer to figure 6-16.

COLUMN A	COLUMN B
6 17. Which chart projection has a straight rumb line?	a. Mercator
	b. Lambert Confrontal
	c. Polar Stereographic
6-18. Which chart projection shows the least distortion of shapes and areas?	d. Transverse Mercator
6-19. Which chart projection can be produced graphically?	

6-20. Assume that you are stationed at NAS Jacksonville, FL. To what/which DMA distribution control point would you submit requisitions for (1) FLIPs, (2) aeronautical charts?

6-21. Which DMA DDCPs fill requisitions processed by Washington, D.C.?

6-22. Which DD or SF form would you use when submitting requisitions via the Automatic Digital Network (AUTODIN)?

6-23. Match each of the following statements with the appropriate DD or SF form(s).

a. Should be mailed.________________

b. May be mailed.________________

c. Message requisition.________________

d. Used when stock number is NOT known. ________________

e. Used by activities having keypunch and electrical transmission capabilities. ________________

6-24. To receive automatic initial distribution of FLIPS and related products, to what/which DMA unit(s) would you forward your request and what/which form(s) should you use?

6-25. In the spaces provided label each of the following publications as being either published or revised "monthly" or "semiannually" as appropriate.

________a. DMA Catalog of Maps, Charts, and Related Products

________b. DMA Aeronautical Chart Bulletin Digest

________c. DMA Aeronautical Chart Updating Manual (CHUM)

________d. DMA Aeronautical Bulletin

________e. DMA Aeronautical Chart Updating Manual Supplement (CHUM Supplement)

6-26. In the spaces provided indicate whether the following statements are "T" true or "F" False. If false, explain.

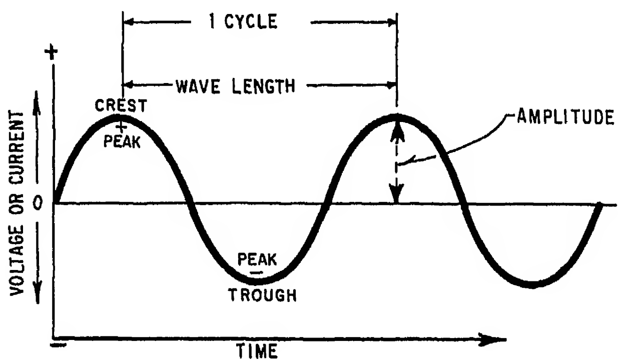
________a. The CHUM, CHUM Supplement, and Aeronautical Chart Bulletins contain updated information which supersedes previous editions and the previous editions may be discarded.

________b. Chart Bulletin Digests and subsequest bulletins verify whether a chart is current or not while CHUMS contain corrections that should be made prior to usage of the chart.

6-27. Within the concept of the FLIP program, what are the basic phases of flight?

NAVIGATIONAL AIDS

Various types of air navigational aids are in use today, each serving a special purpose in the total system. These aids have varied owners and operators—namely, the FAA, the military services, private organizations, and individual cities, countries, and states. However, the FAA has the statutory authority to establish, operate, and maintain a common system of air navigational facilities, and to prescribe standards for the operation of any aids used for IFR flight in controlled airspace. This common system is referred to as the National Airspace System (NAS).



201.106
Figure 6-25.—Hertzian wave nomenclature.

Knowledge of the basic theory of radio, which is applicable to both communications and air navigation equipment increases your understanding of the uses and limitations of radios.

RADIO THEORY

Radiated electromagnetic energy suitable for radio communication is called a hertzian wave. The wave is named for an early German physicist and mathematician named Hertz, who introduced the theory of the kinetic energy of an electrical current. Hertz's discoveries, along with other discoveries, laid the basis for the development of radio telegraphy.

The hertzian wave can be represented by a sine curve as shown in figure 6-25. The top of the wave represents the maximum positive value, and the bottom represents the maximum negative value. Either maximum may be called a peak. Wave length is the distance between corresponding points on consecutive waves as shown in figure 6-25. It is the distance a wave travels during one cycle. Frequency is the number of cycles that occurs per second, stated in terms of hertz, abbreviated Hz; thousands of cycles per second stated in terms of kilohertz, abbreviated kHz; or millions of cycles per second stated in terms of megahertz, abbreviated MHz; or billions of cycles per seconds stated in terms of gigaherts, abreviated GHz. The range of frequencies involved, called the radio spectrum, extends from approximately 10 kHz to 300,000 GHz as shown in table 6-1.

A hertzian wave, as earlier indicated, is an oscillating electromagnetic field. A continuous series of such waves of like characteristics is called a continuous wave (CW). (See (A) in figure 6-26.) Such a wave can be used in Morse code transmissions, being keyed so that the signal is interrupted when desired. (See (B) in figure 6-26.) A continuous wave may be modified in accordance with some characteristics of an audio frequency signal, such as that produced by the human voice. When thus used, it is called a carrier wave. The process of modifying the carrier wave in this manner is called modulation. After this has taken place, the carrier wave may be called a modulated carrier wave. (See figure (C) in 6-26.) When this form of radio transmission is used, the

Table 6-1.—Radio spectrum

Frequency range	Name of the range	Symbol
Below 30 kHz	Very low frequency	VLF
30-300 kHz	Low frequency	LF
300-3,000 kHz	Medium frequency	MF
3-30 MHz	High frequency	HF
30-300 MHz	Very high frequency	VHF
300-3,000 MHz	Ultrahigh frequency	UHF
3,000-30,000 MHz	Superhigh frequency	SHF
30,000-300,000 GHz*	Extremely high frequency	EHF

* Gigahertz

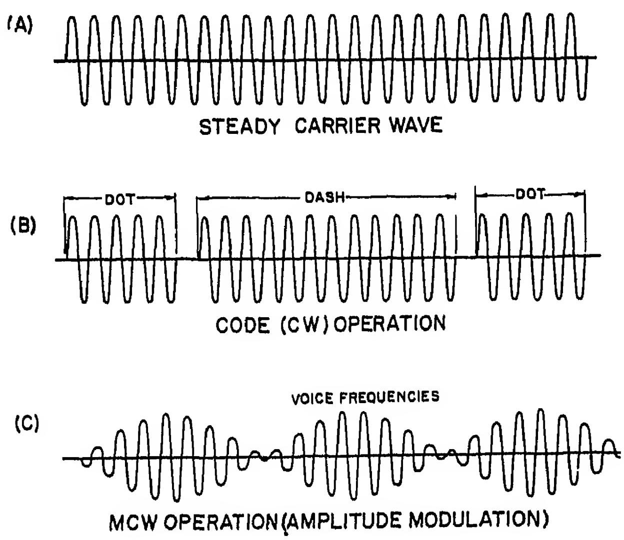


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Figure 6-26.—Types of radio waves.

transmitting station generates the carrier wave and modulates it by the message to be conveyed. The receiver demodulates the incoming signal by removing the modulating signal and converting it to its original form.

There are three principal kinds of modulation. In amplitude modulation (AM), the amplitude of the carrier wave is altered. This is the most widely used form of modulation. In frequency modulation (FM), the frequency of the carrier wave is altered. This is used in some voice communications and commercial broadcasting and has an advantage of being nearly static free. In phase modulation, the phase (amount by which the beginning of a cycle is displaced from a reference origin) is altered. This is similar to FM and has some engineering advantages. In pulse modulation (PM), very short bursts of carrier wave signals are transmitted, followed by relatively long periods during which no signal is transmitted. PM is used in RADAR, DME, and radio teletype.

With amplitude modulation, two sidebands are radiated, the frequencies of which are the sum and difference, respectively, of the carrier and modulating frequencies. The intelligence is carried only on the sidebands. In single sideband (SSB) transmission, the carrier and one of the sidebands are suppressed, producing a narrow bandwidth transmission. Bandwidth is the amount of radio spectrum required for transmission, including the carrier wave and both sidebands when present. SSB transmission is desirable in that it effects economy in the use of limited frequency bands and in power.

Radio Transmitter

A radio transmitter consists essentially of a power supply to furnish direct current; an oscillator to convert direct current into radio frequency oscillations (the carrier wave); an

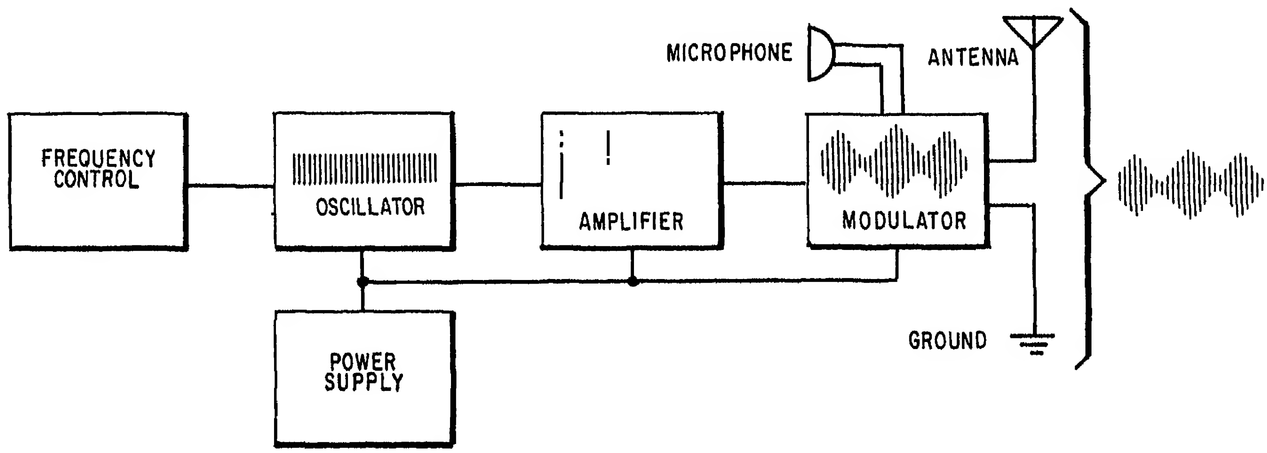

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Figure 6-27.—Radio transmitter.

amplifier to increase the output of the oscillator; a device for controlling the frequency of the generated signal; and, for most transmitters, a modulator to produce modulation of the carrier wave. (See figure 6-27.) In addition, an antenna is needed to project the electromagnetic radiation into space.

Antenna

An antenna can be defined as a conductor or system of conductors used either for radiating electromagnetic energy into space or for collecting electromagnetic energy from space.

In effect, electrical energy from the transmitter is converted into electromagnetic energy by the antenna and radiated into space. On the reception end, the opposite transpires, and this electrical energy is fed into the receiver via the antenna.

Fortunately, separate antennas seldom are required for transmission and reception of radio energy. An antenna transfers energy from space to its input receiver terminals with the same efficiency it transfers energy from the output transmitter terminals into space, assuming, of course, that the same frequency is used in both cases.

This property, the interchangeability of the same antenna for transmitting and receiving operations, is known as antenna reciprocity.

Antenna reciprocity is possible mainly because antenna characteristics are essentially the same regardless of whether an antenna is sending or receiving electromagnetic energy. An antenna may be nondirectional or directional depending upon the design or arrangement of antennas, called an array. Reflectors are also used to reflect some of the radiated energy in a desired direction.

Radio Receiver

When an electromagnetic field passes a conductor such as an antenna, a current is induced in the conductor, which thereby becomes a generator of radio frequency power. A radio receiver is a device which accepts the power thus generated by an antenna, and transforms it into a usable form. The output of receivers most used by ACs is presented aurally via earphones or a loud speaker, or visually on a cathode ray tube as in RADAR.

A radio receiver consists essentially of electrical components capable of doing four things as follows:

1. Selecting a signal of a single frequency from among the thousands existing together in the receiving antenna.
2. Amplifying the selected signal without distortion until it is sufficiently powerful to actuate succeeding devices within the receiver.
3. Demodulating any modulated signal so as to produce a new signal of audible or other usable frequency.
4. Amplifying that signal still further until, at the output of the receiver, it can operate the devices which present the signal in usable form. (See figure 6-28.)

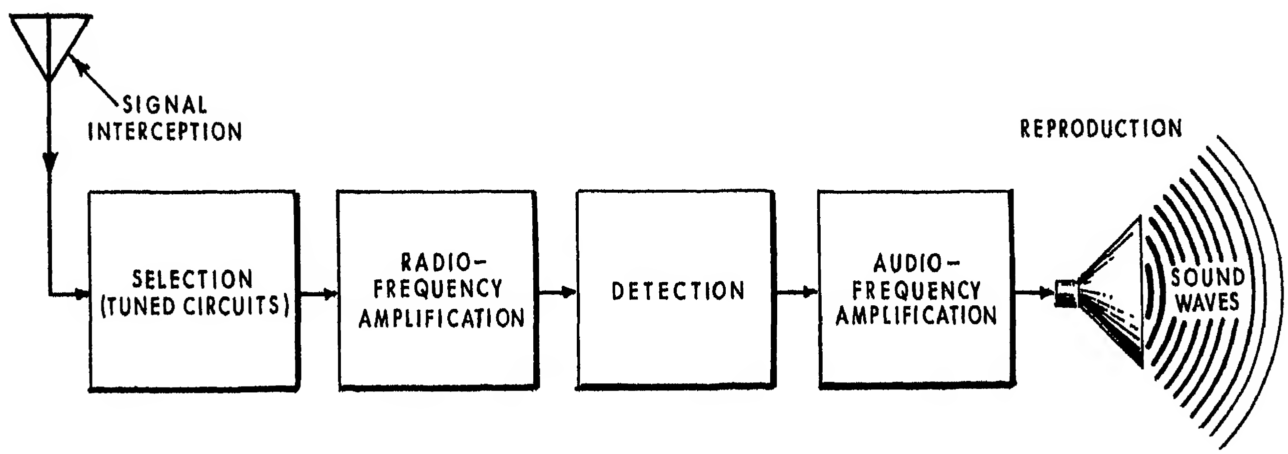

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Figure 6-28.—Radio receiver.

NOTE: For a more detailed study of communications theory and other related data you should refer to *Basic Electronics, Volume 1,* NAVPERS 10087-C.

NONDIRECTIONAL RADIO BEACON (NDB)

Learning Objective: **List the uses and limitations of nondirectional radio beacons for navigation as they relate to ATC.**

To begin let's discuss one of the early aids to navigation—the radio beacon. Although one of the earliest aids, the beacon remains a valuable means of navigation, especially to general aviation pilots.

The term "radio beacon" is a general designation of a class of low or medium frequency range "homing" facilities. The designation "nondirectional" indicates that these facilities provide a signal equally well in all directions. Homing essentially means that the pilot is keeping the nose of the aircraft pointed at the radio aid while proceeding toward the facility.

NDBs are intended for use with airborne direction-finding (DF) equipment to provide the pilot with bearing information and as approach aids when installed in the vicinity of an airport. They normally operate in the low and medium frequency range band of 200-415 kHz. There are some military NDBs in use that operate in higher bands. NDBs vary widely in the amount of radiated power, depending on their class of operation. This, in turn, affects the range at which pilots can receive and use beacons. Beacons are classified as follows:

1. MH Facility—Less than 50 watts radiated power, reception range approximately 25 miles.
2. H facility—50 to 1,999 watts radiated power, reception range approximately 50 miles.
3. HH facility—2000 watts or greater radiated power, reception range approximately 75 miles.
4. L facility—Locator, Outer Marker (LOM). These low power beacons are commonly referred to an compass locators. They are associated with Instrument Landing Systems (ILS). The power output of L facilities is 25 watts or less, and the range is thereby limited to approximately 10-15 miles.

Unless the letter W is included in the class designator—for example, HW or MHW—then voice transmissions can be made over the NDB's facilities. The use of this provision of military controlled NDBs is usually reserved for emergency actions such as issuing general instructions to aircraft which may be navigating by the NDB, but with which your control facility is not in direct radio contact. However, civil controlled facilities routinely transmit weather, NOTAMs, and traffic information over NDBs.

Regardless of whether or not a particular NDB has voice capability, all operational facilities transmit an identifier code. Any radio aid not transmitting an identifier should be considered by both pilots and controllers as unusable. Each beacon throughout the country is assigned a specific radio frequency and an identifier consisting of three letters of the alphabet. This three-letter identifier is transmitted continuously in International Morse Code. For example, the beacon at Atlantic Municipal Airport, Iowa, transmits the assigned identifying letters AIO. A pilot planning to use the Atlantic beacon for navigation would, after selecting the proper frequency, listen to the identifier to assure himself that he is tuned to that specific beacon. L-type facilities fall into a special category in that they transmit only a two-letter identifier. We discuss why when we cover the Instrument Landing System.

While navigating by an NDB, the pilot uses an instrument known as a radio compass for homing and approach guidance. The principle of operation of a radio compass is simple and uses a familiar process. Everyone knows when a portable radio is rotated through a full circle, there are places where the volume becomes louder. The loud spots occur when the receiver's antenna is pointed toward the station to which it is tuned. This, in its simplest form, is the operating principle of a radio compass—orienting an antenna to the best reception spot. In

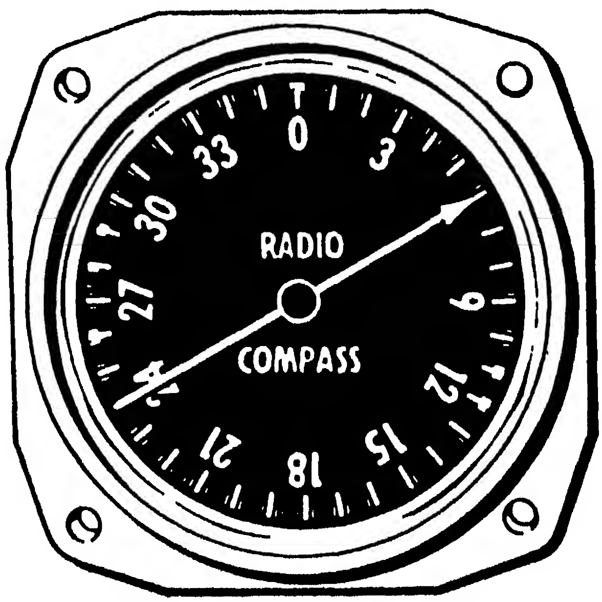

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Figure 6-29.—Radio compass indicator.

figure 6-29 we see a simple indicator used with the radio compass to complete the navigation package. To use the system, the pilot tunes in the desired NDB, identifies it, and adjusts the radio compass antenna for the strongest indication. The direction to the beacon is then indicated by the arrow on the indicator. The pilot then turns the aircraft so that the zero (indicating the nose of the aircraft) is under the arrow pointer and keeps the two aligned until the NDB is reached.

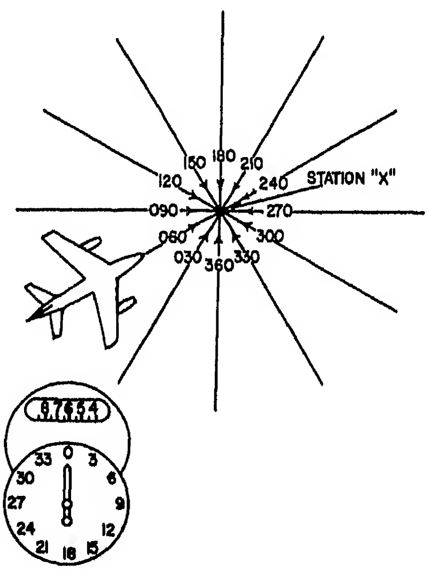
Most radio compasses in today's aircraft accomplish this automatically. This is termed Automatic Direction Finding (ADF).

Automatic Direction Finding (ADF)

Although many new types of direction finding and homing equipment are coming into widespread use, the radio compass still remains a basic and important piece of equipment for homing, tracking, course interception, time/distance checks, and similar purposes. Therefore, a brief description of the basic method utilized in an ADF orientation is included so that you may visualize the "pilot's position" during an ADF orientation.

When the pilot is flying ADF, the problem of orientation is solved automatically. The 0-180 degree axis of the radio compass indicator is aligned with the longitudinal axis of the aircraft. Thus, you can think of 0 degrees on the radio compass dial as representing the nose of the aircraft, while 180 degrees on the radio compass dial represents the tail. The radio compass needle always points toward the station. This means that when the radio compass indication is between 0 and 090 degrees, the station is ahead and to the right of the aircraft. When the radio compass points to a reading between 090 and 180 degrees, the station is behind and to the right. A reading between 180 and 270 degrees shows that the station is behind and to the left, while a reading of between 270 and 360 degrees shows that the station is ahead and to the left. The radio compass needle points to the number of degrees the pilot must turn in a clockwise direction to head directly toward the station. This is called relative bearing of the station.

By adding the relative bearing of the station and the magnetic heading of the aircraft, the pilot can determine the magnetic bearing of the station. This establishes a line of position from the aircraft to the station. By looking at figure 6-30 you can see that the aircraft is approaching the station



201.118
Figure 6-30.—Inbound bearing to station X.

from the southwest. The magnetic bearing of the station is 060 degrees. For the sake of simplicity, we assume that there is no wind drift, so a magnetic heading of 060 degrees is holding the aircraft on this bearing. The radio compass indicates the relative bearing of the station—the angle measured clockwise from the nose of the aircraft to the station. In this case, the relative bearing is 0 degrees.

Limitations of NDBs

Radio beacons and receiving equipment are subject to disturbances which, at times, make their use undesirable to pilots and therefore affect ATC. For example, in homing on NDBs, the radio compass is subject to signal fading and static during stormy weather, just like your portable radio would be. The result is erratic indicator operation. This, therefore, can make NDBs unsuitable for homing approaches or for holding during thunderstorms. At night other distant stations interfere with signal reception in the same way as with standard radio receivers. One other drawback to homing on NDBs, as opposed to the more efficient aids we discuss shortly, is that homing normally results in a curved course being flown rather than a straight course. This is because of crosswinds acting on the aircraft, and the whole situation can be greatly amplified if the pilot is careless with navigational techniques. Imagine several aircraft converging on the same NDB, all flying these greater or lesser curving courses in IFR weather.

EXERCISES

6-28. List three navigational operations that you could expect a pilot to do if he were navigating by an NDB.

6-29. Weather conditions limit the use of NDBs. List another limitation not directly related to weather.

6-30. List two uses of an NDB that has voice capability, as opposed to an NDB which does not have voice capability.

A desire to eliminate the objectional features of the NDB led to the development of "omnidirectional ranges". These systems carry the burden as the primary radio aid to air navigation today.

VHF/UHF OMNIDIRECTIONAL RANGES

Learning Objective: **State the operating principle of "omni" facilities, and explain why they are better aids to navigation for ATC use that are NDBs.**

Omni is from the Latin word Omnis which means all. Theoretically, then, an omnifacility is a facility which produces courses in all directions. We could compare this "all directions" to the NDB, but the difference is that the NDB is something to be homed on whereas the omnirange facility produces courses which the pilot can track to the facility. In actual practice, omnifacilities produce only 360 usable courses but, in theory, any number are possible.

TYPES OF FACILITIES

There are two types of omnifacilities in operation today. They are the very high frequency omnidirection range (VOR) and the tactical air navigation (TACAN) facility. They differ from each other in frequency operating ranges, usage, and components. VORs operate on frequencies between 108.0 and 118.0 MHz, and are used by all types of aircraft for navigation and approach guidance. TACAN facilities operate on frequencies between 960 and 1215 MHz, which are in the ultra-high frequency (UHF) band and are used by military aircraft. There is a third type of facility, which is a combination of the two omnifacilities—VOR and TACAN. This facility is called a VORTAC. It is really incorrect to say that a VORTAC is a combination of VOR and

TACAN. This site provides three individual services: VOR azimuth, TACAN azimuth, and range information. The range information (slant range in nautical miles) is provided by distance measuring equipment (DME) which is an inherent portion of TACAN, but not VOR. We discuss DME separately later on, but for the moment, let's talk about the "how" of VOR and TACAN azimuth courses.

PRINCIPLES OF OPERATION

Courses produced by omnifacilities radiate from the facility like spokes from the hub of a wheel but, as we pointed out, in practice only 360 courses are useable. These courses compare to the 360° points on a compass. Therefore, each radial is numbered according to the degree direction in which it lies from the facility. For example, the 090 radial is always due east of a facility and the 225 radial is always due southwest. Let us see how this comes about.

First, we should point out that there are differences between the methods used in VOR and TACAN to produce these radials. Since the end result is the same, we won't involve ourselves too deeply with this aspect of the operation. The basic function of both facilities is to produce reference signals which, when received by the aiborne equipment and electronically manipulated, pinpoint an aircraft's position in reference to magnetic north from the facility being used. To do this, the omnirange uses two or more electronic signals. One is called the reference signal and the other the variable signal. The equipment is initially aligned so that at magnetic north both signals are "in-step" or in phase. At all other times they are "out-of-step." This is the basis for the airborne equipment to compute something—a phase angle. When it is computed and displayed to the pilot, it translates into a radial from the omnifacility to which the VOR or TACAN receiver is tuned. We said a moment ago that two or more signals are produced by the facility. This was because, in the case of TACAN, three signals are used to compute the radial; whereas, in VOR, only two are needed. The difference came about because of peculiar military requirements such as unusual siting conditions; e.g., on-board pitching and rolling naval vessels. Therefore, the extra signal was needed for computation for such unusual conditions.

To help you visualize what is taking place between the omnitransmitter and the airborne receiver, perhaps the following simplified explanation will help. Assume that there are two lights on a pole, one on top of the other. The top light is removable, but the bottom light is stationary. Both lights are on continuously. The stationary light is aligned so that it continually points to magnetic north, while the movable light is adjusted to rotate at one revolution per minute. Now, only when both lights are pointing to magnetic north are they "in-step." At all other times there is a difference between the two which is measurable. We could measure it by using a stop watch, and we could compute a position (or radial) from the site. If, when the lights are in-step, we start a stopwatch and the moment the rotating light sweeps past our position we stop the watch, we have recorded in seconds the phase difference between "in-phase" and position. (See figure 6-31.) If we then do some simple math, we can fix our position. For example, we record a

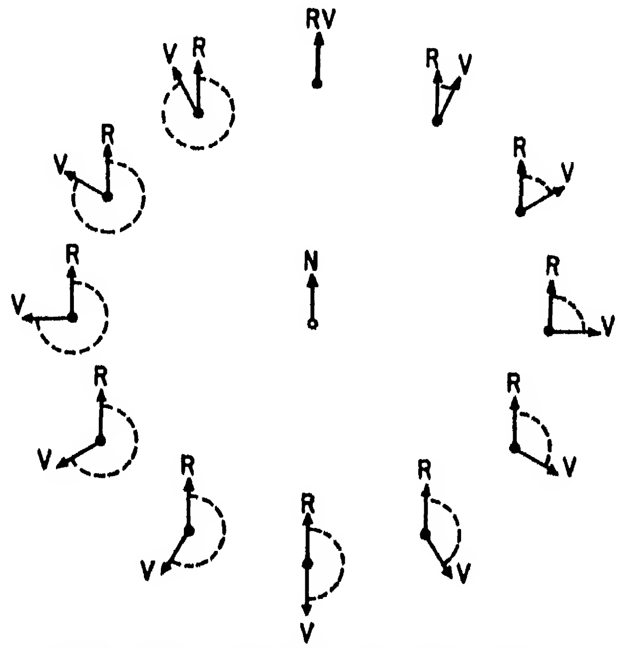


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Figure 6-31.—Comparison of reference and variable phase.

time lapse of 25 seconds; at one revolution per minute each second is equal to 6° of difference from in-step. Therefore, 6 × 25 = 150° from in-step. This, then, equates to the 150 radial. Obviously, this is greatly speeded up in actual operation. A VOR's rotating signal, for example, revolves at 1800 RPM. Since the fixed reference is orientated to magnetic north, we can see that any given degrees from the in-step condition physically fixes the radials to their proper geographical position from the facility.

ADVANTAGES TO ATC OF OMNIRANGES

We are sure that you have already spotted several reasons why omniranges are preferable to NDBs. Just to make certain, let's cover several of the most important ones. Three reasons why omnifacilities are better than NDBs quickly come to mind: (1) they provide straight courses, (2) they are not subject to atmospheric disturbances, and (3) more accurate position fixing is obtainable. We have a few words about each of these points.

1. Straight courses. Since omniradials are themselves directional, once a pilot has "locked on to" a radial, it is assured that a straight track along the radial will be flown by the aircraft with little variance to either side of the radial centerline. Look at figure 6-32. Notice that at 60 nautical miles the radial is only 1° or 1 nautical mile wide. Also notice that the radial becomes narrower closer to its source. Straight courses, as opposed to curving courses, assure more accurate and safer flying. Accuracy in navigation, in turn, influences ATC procedures and standards. The end result is easier and simpler control procedures for you to remember and follow.

2. Atmospheric disturbances. Radio waves leaving an antenna travel in one of two ways. They either follow the curvature of the earth, or they go out on a level plane. The NDB's waves follow the curvature of the earth, whereas the omniwaves go away from the antenna on a straight and level plane. Waves which follow the curvature of the earth are affected by terrain irregularities. Mountains and magnetic disturbances that exist between the transmitter and the aircraft can, and do, cause deceptive signals. NDBs are also subject to static and interference which cause their signals to be interrupted and often distorted beyond recognition. Omnifacilities, on the other hand,

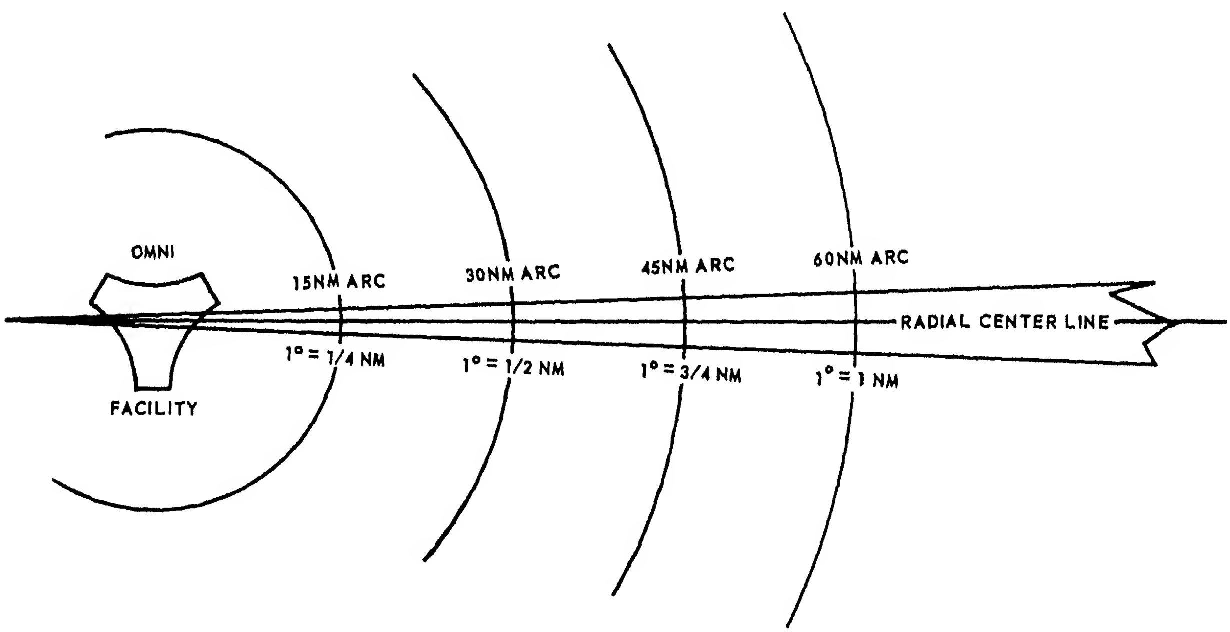

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Figure 6-32.—Width of radials at various ranges.

operate in the VHF and UHF bands. The VHF and UHF bands have distinct advantages over the lower bands which the NDBs and other older types of facilities use. The first advantage is that they are nearly static-free. Another advantage is accuracy created by line-of-sight transmission. (See figure 6-33.)

3. Accuracy in position fixing. Navigational aids using frequencies in the VHF/UHF bands can be placed closer together without interfering with each other. This allows pilots to cross-check a position with another nearby aid, thereby adding to navigational accuracy. Also, the development of radials by omnifacilities speaks for itself in improving position accuracy.

EXERCISE

6-31. Complete the following statement: Omnifacilities use at least two signals in establishing radials. They are commonly known as the ________ and ________ signals; airborne equipment measure the ________ between these signals which identifies specific radials of omnifacilities.

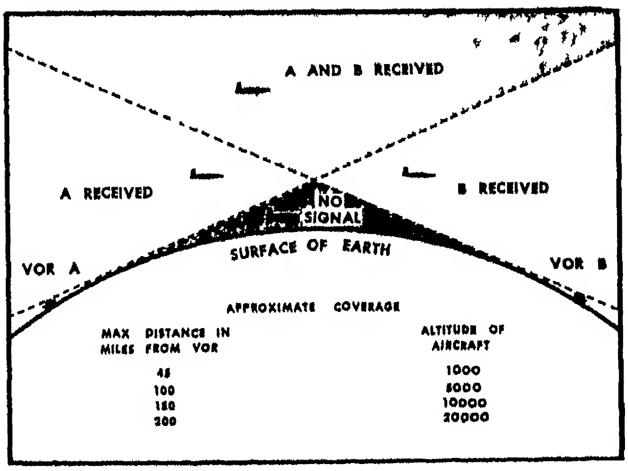

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Figure 6-33.—Line-of-sight transmission characteristics.

6-32. Write a short comparative statement about each of these features of omnifacilities which explains why they are better aids to navigation than are NDBs.

a. Radio courses.

b. Line-of-sight signal transmission.

c. Locating omnifacilities closer together.

DISTANCE MEASURING EQUIPMENT (DME)

Learning Objective: **Identify the types of facilities with which DME is associated, and, list the advantage of DME.**

Distance from a known ground point is another item of information necessary to accuracy in navigation. Today, most pilots obtain this data from DME associated with, collocated at, or in some cases an integral part of, any one of a number of navigational facilities. Before the advent of DME, if the pilot was to know his position with any accuracy, he had to make cross-checks (when he could) with other facilities or make time-distance computations. Both of these methods contained a lot of variables and, at best, the pilot could only be assured that he was reasonably close to the position computed. Not so with modern DME. Operating in the UHF band at frequencies between 960-1215 MHz on the line-of-sight principle, DME furnishes distance information with a very high degree of accuracy. Reliable information may be received at distances of up to 125 nautical miles, at line-of-sight altitude, with an accuracy of better than 1/4 mile.

As we mentioned earlier, DME measures slant distance rather than horizontal distance over the ground. Except in the immediate vicinity of the DME facility, at relatively high altitudes, the navigational error introduced by slant range measurement is minor and normally ignored by both pilot and controller.

The availability of DME to a pilot depends on two factors: (1) whether there is DME associated with the facility being used, and (2) whether the equipment needed is on board the aircraft. Since DME is used in conjunction with several types of navigational aids, careful use of terminology in referring to these aids is necessary along with a basic understanding of the match-up of facilities. First, we briefly explain item 2. There are two parts to every DME system—the ground station called the transponder and the airborne portion called the interrogator. In operation, inquiries are sent from the interrogator to the transponder, which replies with data that the interrogator can process and display to the pilot. In this instance it is in the form of miles from the transponder site. Without either component of the system, no distance information is possible.

In the following text we discuss the three types of facilities with which DME is associated.

VOR/DME. This is a site which furnishes azimuth information from a VOR and distance information from a DME facility. As we have pointed out, these are two separate facilities which are physically located at the same site. A pilot may get any information desired from such a site, limited only by the airborne equipment. Another point about this type of facility is that they are always frequency paired. For example, a VOR with a frequency of 110.0 MHz will have an associated DME with a frequency of 998 MHz.

TACAN. This is the military equivalent of VOR/DME. Its use is limited, however, to aircraft which have the special TACAN receiver. A big benefit of TACAN is that DME is an integral part of the system and not a separate facility as it is in VOR/DME installations. Also, it should be noted that TACAN facilities are identified by a channel number rather than a frequency.

VORTAC. At a VORTAC site the separate courses are furnished by the individual components of VOR and TACAN while all distance information is provided for by the DME portion of the TACAN. VORTAC sites are identified by both frequency listing and channel numbers. This arrangement makes it easy for the pilot to select those portions of the facility which are compatible to his airborne equipment.

DME is sometimes associated with an Instrument Landing System (ILS). This provides the pilot with distance information from the touchdown point on the runway. In such an arrangement, the DME transponder is located at the ILS glide slope site.

Many advantages to both pilots and controllers are made possible through the use of DME. We would like to reveiw with you some of the more important advantages. It is not our intent here to get into the specifics of application of these advantages; we only want to identify them from a general viewpoint. First of all, through the use of DME, reduced separation standards are possible. This is a credit to the accuracy of the DME system. Second, enroute courses which "arc" about such areas as terminal areas, and precise holding patterns are made possible. These enroute "arcs" cut down on traffic congestion over navigational aids by decreasing the need for aircraft to be flown to the physical site of an aid before changing courses. It is now a very simple action for the pilot to maneuver from one radial/DME fix to another. With reference to holding, because DME holding patterns themselves have been "tightened up" and are more precise, this is a real improvement over older methods. This allows more traffic to be compressed into the same airspace. Patterns are now mostly flown between accurate DME fixes. Finally, a point which is of special interest to controllers: aircraft equipped with DME can be held with accuracy at any point within range of the facility. Holding is no longer limited to intersections, homing facilities, or the like. What DME does is to provide everyone with many accurate reference points along given paths which are easily identified by both controller and pilot. This, in turn, gives way to the many control options that we discuss in later chapters.

EXERCISE

Use the follwing list of common navigational aids for reference when answering exercise questions 6-33 and 6-34.

a. Nondirectional radio beacon.

b. Instrument landing system.

c. Very-high frequency omnidirection range.

d. Tactical air navigation.

e. VHF omnidirection range/radical air navigation.

6-33. List the letters identifying the above facilities which will always have associated DME.

6-34. List the letters identifying the above facilities which may have associated DME.

6-35. List four benefits that the addition of DME has given navigation.

6-36. Summarize in a single statement what you feel is the overall operational advantage gained because a navigational aid has associated DME as opposed to a non-DME equipped aid.

OMNIRANGES, GENERAL

The following general information on omniranges helps you become a better controller through understanding the use and limitations of the equipment at hand. In addition, this information is helpful to you when preparing for advancement.

Reception Distance

Like all VHF/UHF transmissions, omnifacility signals follow and approximate line-of-sight course. (See figure 6-33.) Therefore, reception distance increases with an increase in the altitude of an aircraft. Since the reliable operating range operating is about 40 miles at minimum en route altitude (1,000 ft above terrain), omnifacilities are spaced approximately 90 miles apart to assure navigation coverage over an airway. Due to the operational band of the omnifacilities, they are relatively free of atmospheric and precipitation static.

Classification

VOR, VORTAC, and TACAN NAVAIDS are classed according to their operational use. There are three classes as follows:

T. . . . . Terminal

L. . . . . Low altitude

H. . . . . High altitude

Table 6-2 shows the anticipated altitude and interference-free distance service. It is apparent from the table that this is not maximum range of the facility. Use of these facilities beyond the prescribed limitations is not intended, and may therefore result in undependable or inadequate indications in the aircraft.

Identification

VORs are identified by two methods consisting of the ground facility transmitting one of the following:

1. A 3-letter identifier in Morse code.
2. A recorded automatic voice identification announcing the name of the facility followed by the word "VOR".

Table 6-2.—Altitude and radius distances

Class	Altitudes	Distance (miles)
T	12,000' and below	25
L	Below 18,000'	40
H	Below 18,000'	40
H	14,500' -- 17,999'	100*
H	18,000' -- FL 450	130
H	Above FL 450	100

*Applicable only within the contiguous 48 states.

Identification of VOR facilities is transmitted continuously except when interrupted by an actual voice transmission on the voice feature of the NAVAID, or during periods of maintenance, in which case the identification of the facility is removed.

TACANs are identified by ground facility transmission of a 3-letter identifier in Morse code at regular intervals of 37.5 seconds.

VORTAC identification requires identification of both the VOR and TACAN portions of the facility. The procedure is basically the same as for individual facilities except they are interlocked; i.e., the VOR identification is continuous except at regular intervals of every 37.5 seconds when the TACAN is identified. Where the recorded automatic voice identification is used for the VOR portion, it consists of the name of the facility followed by the word VORTAC.

VOR Receiver Checks

Federal Aviation Regulations Part 92, provides for certain VOR equipment accuracy checks prior to flight under instrument flight rules (IFR). The FAA has provided the following means of checking VOR receiver accuracy:

1. VOR test facility (VOT).
2. Certified airborne checkpoints.
3. Certified checkpoints on the airport surface.

The VOR test facility (VOT) transmits a test signal for VOR receivers which provides a convenient and accurate means to determine the operational status of their receivers.

Airborne and ground checks consist of certified radials that should be received at specific points on the airport surface, or over specific landmarks while airborne in the immediate vicinity of the airport.

Should an error in excess of plus or minus 4 degrees be indicated through the use of the ground check, or plus or minus 6 degrees using the airborne check, IFR flight should not be attempted without first correcting the error.

In addition to the above procedure, the Navy has established checkpoints to taxiways, usually in close prximity to the warmup area, or those taxiways used just prior to taxiing on the runway. These checkpoints consist of a position on the taxiway, marked by a yellow triangle painted on the surface, and a painted sign adjacent to the taxiway that indicates the distance and bearing to the TACAN/VOR from a position directly over the triangle.

Capabilities and Limitations

The VOR and TACAN characteristics are similar with the exception of VOR providing bearing information only and operating in the VHF frequency band. Since TACAN is widely used throughout the Navy as a primary NAVAID, no reference is made to VOR in this section.

The TACAN system employs 126 two-way operating channels of two MHz spacing within the frequency range of 960 to 1215 MHz. Bearing information is available to an unlimited number of aircraft within range (line of sight) of the facility. Distance information is also limited to line of sight and normally extends from 0 to 195 miles. Newer equipment may provide distance information to 300 miles. A ground facility can reply to as many as 120 interrogations for distance information simultaneously. Thus it can be said that each of the 126 TACAN channels available provide full service (bearing and distance) to as many as 120 aircraft simultaneously.

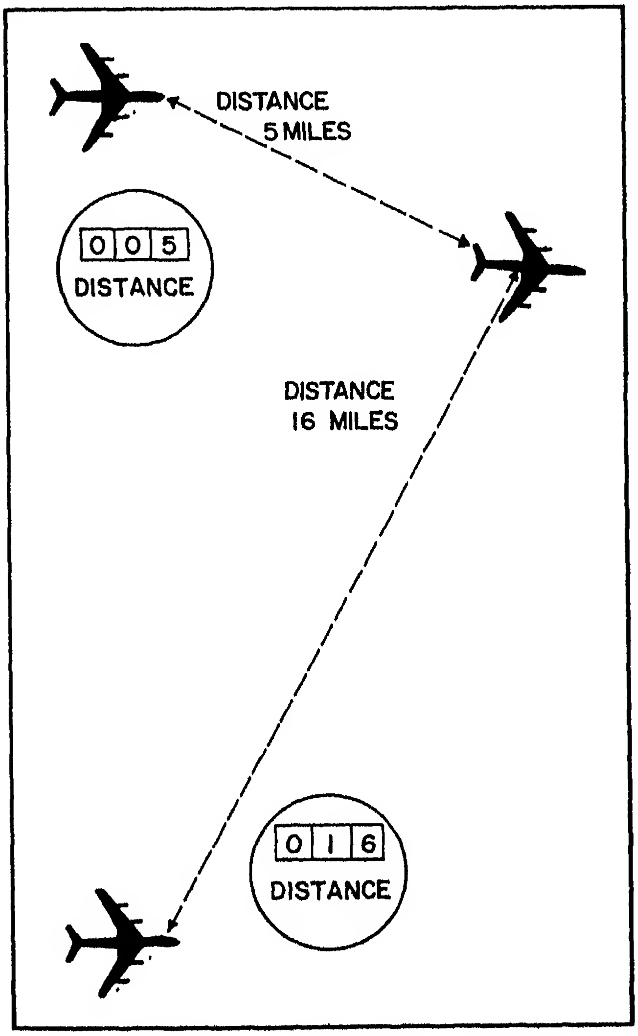
NOTE: In addition to servicing 120 aircraft, two distance signals are generated, processed, and used by the monitoring equipment. This ensures ground station reliability.

TACAN bearing accuracy is plus or minus 3/4 of 1 degree. The distance accuracy is about plus or minus 600 feet plus 2 percent of the distance measured.

Atmospheric conditions above 50,000 feet are such that the high voltages within the equipment are sufficient to cause arcing. Therefore, TACAN operation is limited to altitudes up to 50,000 feet.

On later models of airborne TACAN equipment, air-to-air ranging has been added which provides distance information between airborne TACAN radio sets. To accomplish this function, pilots of the aircraft concerned must agree upon selection of two different TACAN channels which are separated by exactly 63 MHz. If such a capability exists, an airborne TACAN

radio set can transmit distance reply signals to interrogations from as many as five other sets simultaneously. At the same time, the set will receive replies to its own interrogations from all five other sets. However, only the distance to one other set can be displayed on the aircraft's distance indicator. No bearing information is available between aircraft when the air-to-air ranging feature of the equipment is selected. Also, ground-to-air information is not available when the air-to-air feature is selected. Figure 6-34 is an example of the visual display provided the pilot when the air-to-air feature is selected.



201.113

Figure 6-34.—Air-to-air ranging.

Aircraft Instrumentation

The purpose of this section is to provide you with an idea of the practical use of TACAN and the basic aircraft instruments involved. There are several types of instruments, or modifications thereof, available, and new ones are being produced continuously to provide Navy pilots with the best possible navigation assistance. The instruments depicted here are not to be considered as standard in Navy aircraft. VOR is not referred to due to similarity of operation with the exception that VOR provides bearing information only and operates within the VHF frequency band instead of the UHF band as does TACAN.

Figure 6-35 shows a TACAN control box and the various switches. The control system labeled CHAN allows a pilot to select one of the 126 operating TACAN channels available. The switch at the upper right hand side of the control box allows a pilot to turn the TACAN set off, receive only (REC) which provides bearing information only, transmit/receive (T/R) which provides both bearing and distance information, or air-to-air ranging (A/A) which provides distance information between airborne TACAN radio sets. The volume control selects the desired volume level of the identification of the TACAN channel selected. This 3-letter Morse code identification of the TACAN and is heard in the pilot's radio headset.

Figure 6-36 shows three basic instruments used for TACAN air navigation. They are as follows:

1. The range indicator, which displays distance in nautical miles to the TACAN station selected by the channel selector.

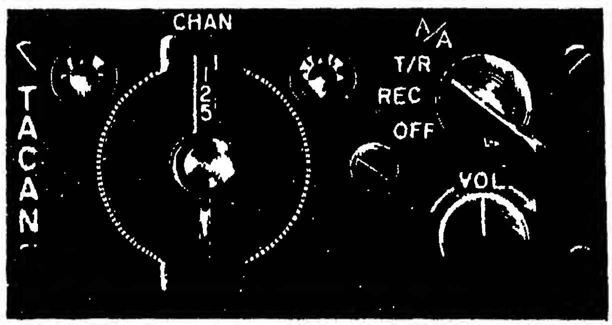


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Figure 6-35.—TACAN control box.

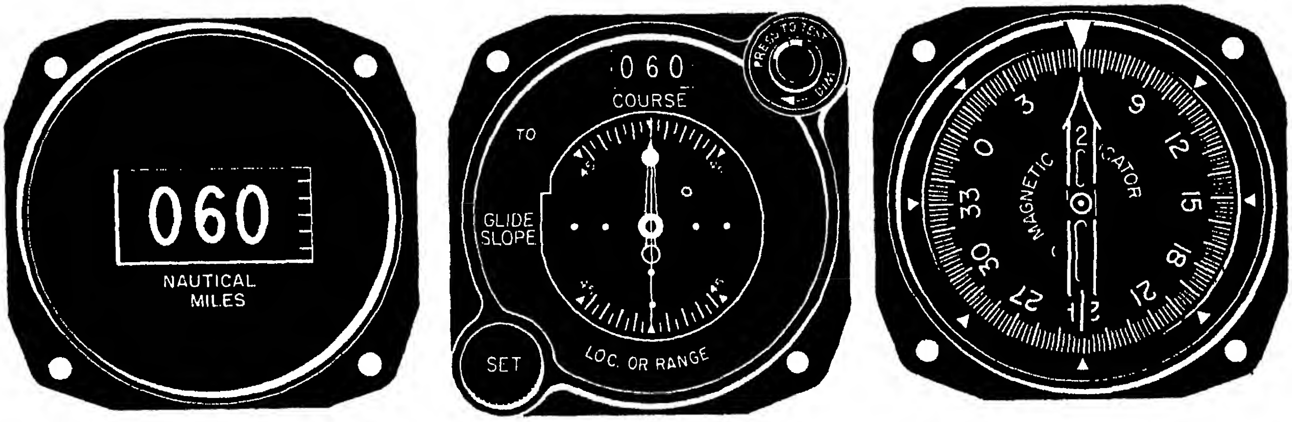

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Figure 6-36.—Range indicator, course indicator, and radio magnetic indicator.

2. The course indicator, which displays the following:

a. The relative position of the course selected (the window labeled course) to the aircraft (vertical bar).

b. Whether the selected course will take the aircraft TO or FROM (TO-FROM indicator on the left side of the instrument) the station.

c. The relationship of the aircraft's heading (vertical needle) to the course selected.

3. The radio magnetic indicator (RMI), which displays the following:

a. The magnetic heading of the aircraft (rotating compass card).

b. The relative bearing of the TACAN station from the aircraft (large needle with the number 2 on it).

NOTE: There is another small needle used on the RMI for automatic Direction Finding (ADF), which is discussed later in this chapter, but is not shown in figure 6-36.

Figure 6-37 is an example of maintaining flight along a specified TACAN radial by correcting for wind drift.

Figure 6-36 is the actual instrument display of the aircraft's position No. 1 in figure 6-37 as follows:

1. The range indicator shows that the aircraft is 60 miles from the TACAN station.

2. The course indicator shows that the aircraft is on the selected course (060) which will take it TO the station.

3. The radio magnetic indicator (RMI) shows that the aircraft's magnetic heading is 060 and the TACAN is directly ahead of the aircraft.

At position No. 2 of figure 6-37, wind has blown the aircraft off the radial. The instruments indicate this as follows:

1. The range indicator shows that the aircraft is now 50 miles from the TACAN station.

2. The course indicator shows:

a. The selected course (060) which will take the aircraft TO the station is left of the aircraft's position (vertical bar).

b. The aircraft's heading is parallel to the selected course (vertical needle).

3. The RMI shows that the aircraft's heading is still 060 magnetic, but the TACAN station now bears left of the aircraft's nose.

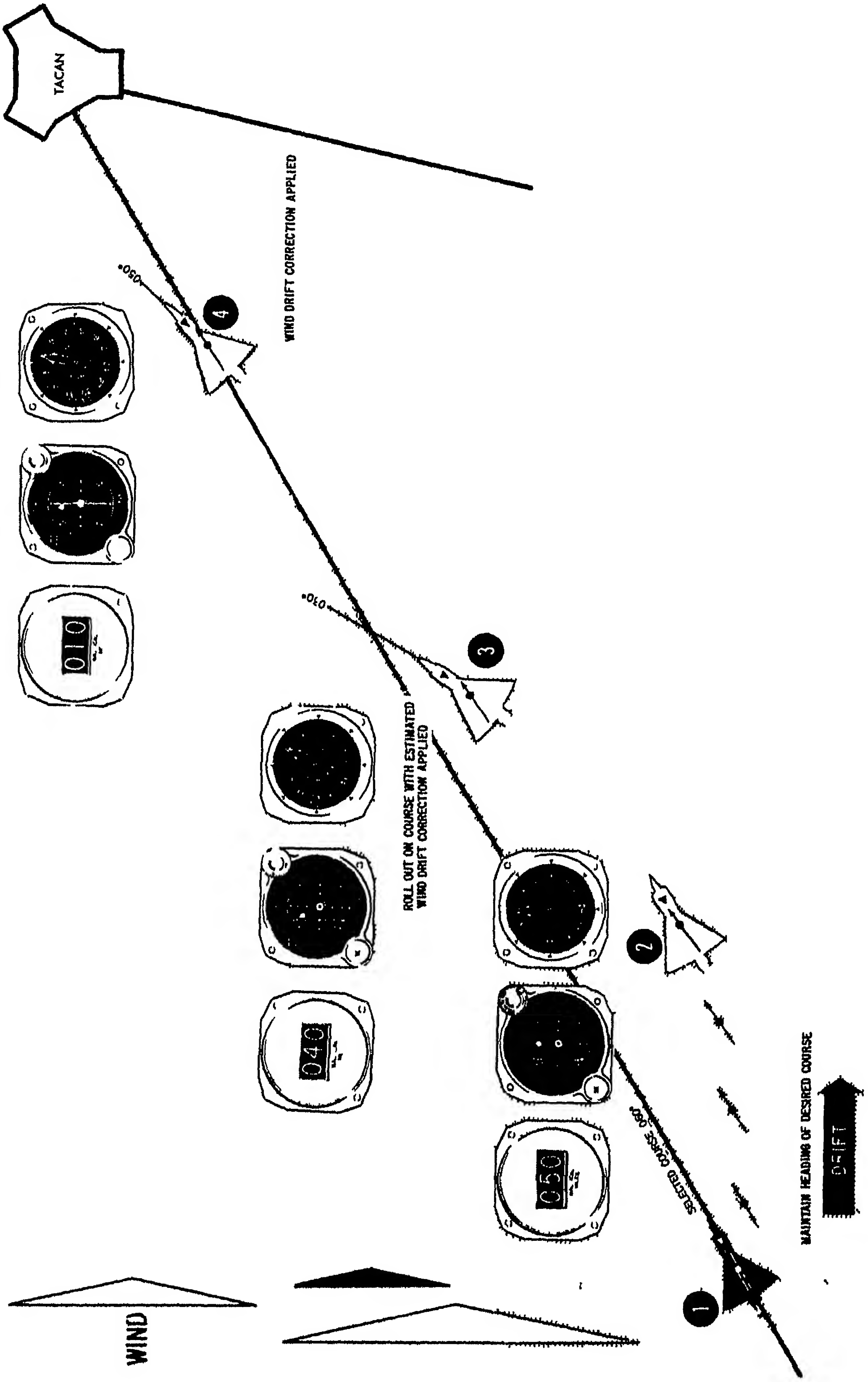

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Figure 6-37.—Flying A TACAN radial.

The pilot must apply corrections to return the aircraft to the desired radial. Position No. 3 shows the instrument display after the corrections have been made as follows:

1. The range indicator shows the aircraft is now 40 miles from the TACAN station.
2. The course indicator shows that the selected radial (060) is still left of the aircraft's position (vertical bar), and the heading of the aircraft will intercept or is toward the selected course (vertical needle).
3. The RMI shows that the pilot has changed the magnetic heading to 030 and the TACAN Station now bears to the right of the aircraft's nose.

Position No. 4 shows the aircraft back on course with a corrected heading to maintain such course as follows:

1. The range indicator shows the aircraft is now 10 miles from the TACAN station.
2. The course indicator shows the following:

a. The aircraft is back on the selected radial (vertical bar) which will take it TO the station.

b. The aircraft's heading is left of the course selected to compensate for the wind (vertical needle).

3. The RMI shows the aircraft's magnetic heading is 050 and the TACAN station bears right of the aircraft's nose.

When the aircraft passes over the station, distance on the range indicator will commence to increase, the vertical bar on the course indicator will fluctuate from side to side momentarily, the TO-FROM indication on the course indicator will change to FROM, and the needle on the RMI will rotate aimlessly, then stabilize 180 degrees from the bearing approaching the station, or point aft of the aircraft to the TACAN station. The reason for the course indicator and RMI TACAN needle fluctuation is a large cone of ambiguity directly over all TACAN stations in which no bearing information is received. This cone of ambiguity is 100 degrees. Therefore, the instruments which use bearing information will not settle down until an aircraft has passed through the cone. However, distance information is constant; and since it is slant range, there will be a reading of distance directly over the TACAN station which indicates the vertical distance or altitude of the aircraft. (See figure 6-38.)

TACAN may also be used to maintain a constant distance, called ARC,-from a TACAN station. To accomplish this a pilot would, after arriving at the desired distance (ARC), select a magnetic heading on the RMI to cause the RMI TACAN needle to point off the aircraft's wing or 90 degrees relative to the TACAN station. Then the magnetic heading would be altered slightly to maintain a constant distance or fly the ARC, and constant relative bearing to the TACAN station.

INSTRUMENT LANDING SYSTEM (ILS)

The most precise enroute navigation system is of little value unless an approach and landing can be successfully completed at the aircraft's destination. Since the early days of instrument flight, approach procedures have been developed and used with a high degree of safety. In the early 1930s, the then Department of Commerce began work on a project designed to increase the reliability of the all-weather flight. Most needed was a system that would permit landings under low ceiling and poor visibility conditions. From this project evolved the Instrument Landing System (ILS), which is one of the most widely used landing systems in operations today.

Learning Objective: **Given a typical ILS layout, identify, by location, the component parts and state the purpose of each.**

The ILS is a precision approach system that provides alignment and descent guidance to the pilot. It consists of three basic components: (1) a highly directional course transmitter, called the localizer; (2) a transmitter to provide a glidepath, known as the glide slope transmitter, and (3) marker beacons to provide accurate fixes

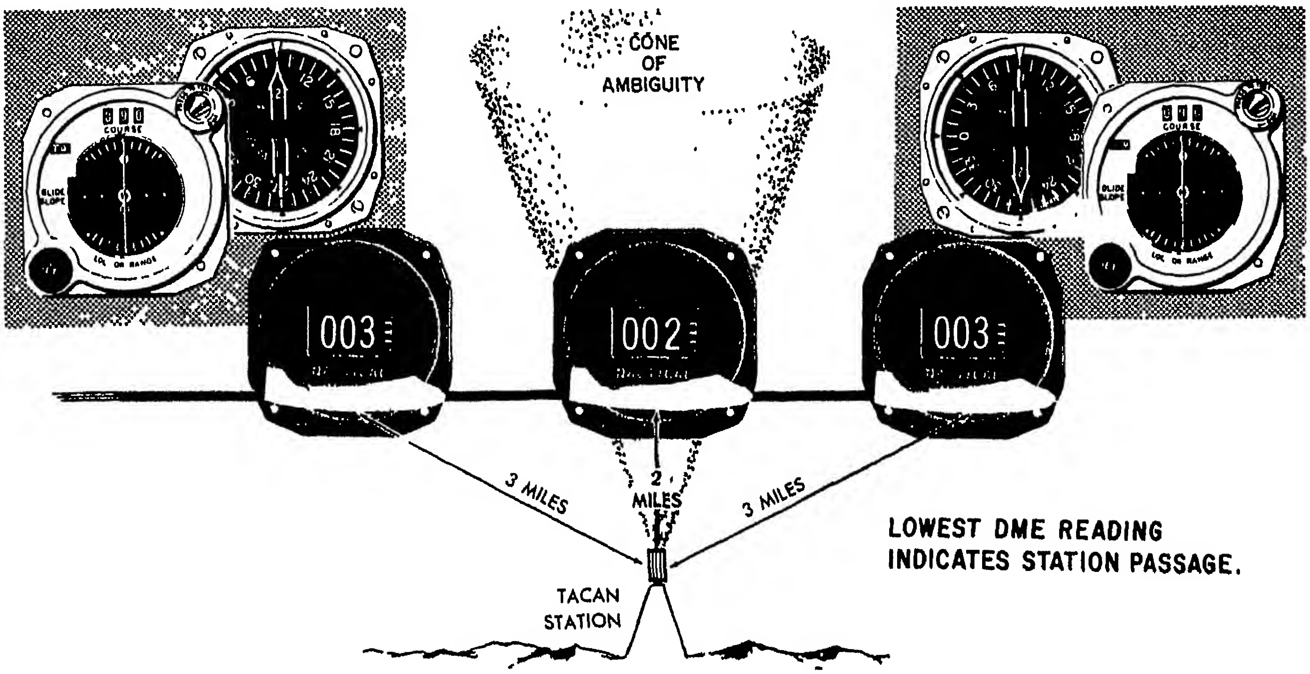

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Figure 6-38.—TACAN station passage.

along the approach path. The visual aid segment is the particular approach light configuration that is installed. Additional supplementary components are:

- Compass locators.
- DME.

Each ILS is categorically classified according to the performance capability of the ground equipment. These categories and their performance standards are:

a. Performance Category I. An ILS capable of providing acceptable guidance information down to a decision height (an altitude in feet MSL at which a missed approach is made if the pilot cannot complete the approach visually) of not less than 200 feet.

b. Performance Category II. An ILS capable of providing acceptable guidance down to a decision height of not less than 100 feet.

c. Performance Category III. An ILS capable of providing acceptable guidance information without decision height minima.

If you look now at figures 6-39 and 6-40, you will see a typical ILS installation. Study the layout until you are familiar with the location of the various components. We discuss their individual functions starting with the localizer.

Localizer Transmitter

The localizer and associated components are placed at the opposite end of the runway to be served by the ILS. The localizer antenna is sited so that the center of the antenna is in line with

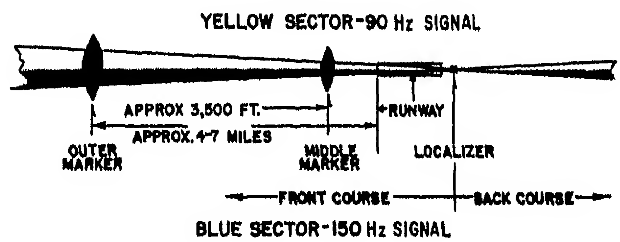

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Figure 6-39.—ILS localizer installation.

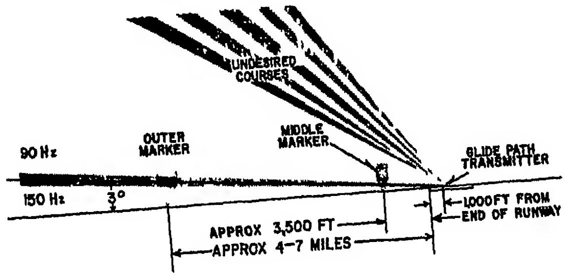

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Figure 6-40.—ILS glidepath and marker installation.

the centerline of the runway. Two signals are produced by the localizer's transmitter and radiated by the antenna. The alignment is such that one signal is radiated to each side of the runway centerline. However, the arrangement is such that at the runway centerline point the two signals overlap with equal strengths. This overlap section forms what is known as the front course. Most localizers produce a signal pattern of sufficient size that an overlap of the two signals is also created to the rear of the antenna. This forms what is known as the back course. Civilian operated ILSs provide a usable back course, whereas military ILSs do not. The localizer provides front course guidance to a distance of approximately 18 NM from the antenna site at altitudes of 1000 feet above the highest terrain to 4500 feet above the antenna elevation. Finally, ILS localizers transmit on odd decimal frequencies from 108.1 to 111.9 MHz (e.g., 110.3, 110.5, 111.7). They transmit a continuous identification code consisting of the 3-letter station identifier preceded by the letter "I". It should be noted also that some localizers have the ability to transmit voice.

Glide Slope Transmitter

The glide slope is the feature of an ILS which makes an ILS approach a precision approach. This feature provides the pilot with an electronic glide slope. The glide slope transmitter and antenna are normally located 1000 feet down the served runway from the approach end and 500 feet from its center line. Like the localizer, two signals are radiated from the antenna. One signal is below the desired glide slope angle and the other above. The equipment is adjusted so that an overlap of the two signals occurs at the desired degree of glide slope to form the glide slope. The glide slope signals are radiated out the front course only; therefore, a back course approach would not be a precision approach and would have higher approach minimums. Likewise, should the glide slope be inoperative for a period of time, higher minimums on the front course would apply because of the lack of glide slope data. Glide slope transmitters operate in the UHF band between 329.3 and 335.0 MHz. The frequencies are paired to specific localizer frequencies so that when the localizer is "dialed in," the proper glide slope frequency is simultaneously selected. Glide slope transmitters provide usable signals to an approximate range of ten miles. One last point—glide slopes do not transmit identification signals.

Marker Beacons

Marker beacons are very low powered 75-MHz transmitters located along the ILS approach course. These provide position information along the approach course. Beacon passage is identified in the aircraft in two ways: (1) by an aural tone as the aircraft passes over the beacon, and (2) by a light on the instrument panel. The outer marker beacon is normally located four to seven miles from the end of the runway and is considered to be the ILS final approach fix. Identification (aural and visual) of the outer marker is characterized by a series of continuous dashes. Glide slope interception normally occurs near the outer marker. The middle marker, on the other hand, is located approximately 3500 feet from the runway and is identified by a series of alternating dots and dashes. Category II ILS installation also includes an inner marker located between the middle marker and the runway threshold. This marker is identified by a continuous series of dots at the rate of six dots per second. The inner marker alerts the pilot to the fact that he has reached the point on the glide slope where decision height occurs.

EXERCISE

6-37. Refer to figure 6-41 and complete these statements:

a. Circled item one is the ________; its purpose is ________.

b. Circled item four is the ________, it produces the ________.

c. Circled item three is the ________; it produces the ________.

d. Circled item two is the ________, its purpose is ________.

MONITORING NAVIGATIONAL AIDS

The most refined of the navigational aids is of little value when it is not working. Only when these aids are "on the air" and functioning properly can you and the pilot make use of their data. It is therefore essential that all persons concerned know the status of NAVAID equipment at any given time. To fulfill this objective, a system for ground monitoring of NAVAIDs has been developed. You, the controller, play an important role in this system because you are normally the first to know of changes in the status of NAVAIDs in your terminal area. Being first automatically assigns to ATC the responsibility for alerting others who are concerned, such as arriving air traffic, base operations, and the Electronics Maintenance

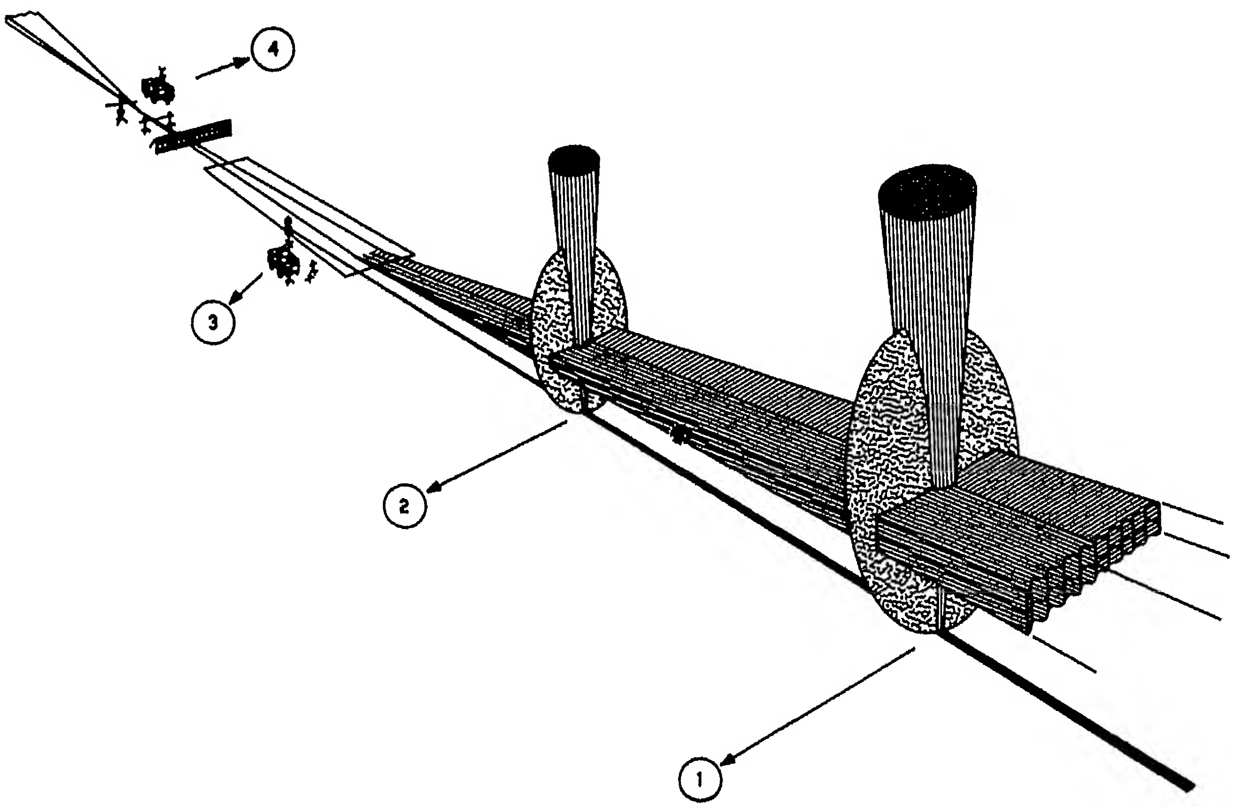

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Figure 6-41.—ILS layout.

Officer (EMO) who in turn notifies the proper maintenance personnel.

Learning Objective: **Distinguish between true and false statements concerning the minimum standards required for monitors, monitor facilities, and monitoring of NAVAIDs.**

Types of Monitoring

We have three types of monitoring to discuss with you. The type of monitor being used determines the regulation requirements for monitoring. These three categories are (1) continuous monitoring, (2) noncontinuous, and (3) local monitoring. Let's start with local monitoring. This term refers to the fact that monitoring of the NAVAID is being conducted at the physical site of the NAVAID and not at the primary facility—hence the term "local monitoring." Local monitoring of a navigational aid is permitted when the remote monitor at the monitor facility is inoperative due to either monitor equipment malfunction or line difficulties. However, to authorize local monitoring, these minimum requirements must be met:

- An operational requirement must exist.
- Monitor equipment at the NAVAID site must be operational.
- A person familiar with the monitor indications is continuously at the site.
- Reliable two-way communications are available between the NAVAID site and the designated monitor facility.
- The designated monitor facility is advised immediately of any NAVAID transmitter or monitor malfunction.

Jumping now to the noncontinuous type of monitoring, we need some sort of accompanying definition of noncontinuous monitoring. It is usually considered to mean that the designated monitor facility is unmanned during certain periods. For example, not all ATC facilities operate 24 hours a day. Some cease operations at sunset because the traffic situation does not warrant their continued function. Therefore, should a facility of this category be the primary monitor facility for a NAVAID, something must be worked out regarding the status of the NAVAIDs. Two courses of action are open and authorized.

1. Designate the responsibility for monitoring to another function, provided:

   a. The other function is continuously manned.

   b. Remote monitoring capability for each navigational aid is installed in the function.

   c. Detailed procedures, including responsibility for reporting outages to the NOTAM agency in the event of a malfunction, are contained in a local operating procedure.

2. Publish in the appropriate flight information publication the periods of operation of the NAVAID which coincide with the period that the monitor facility is manned.

Continuous monitoring is self-explanatory. It means, of course, that the primary monitor facility is manned at all times and qualified personnel are on duty to take action as necessary should the NAVAID or the monitor not function.

Monitoring Responsibilities

We have referred to the designated monitor facility and primary monitor facility. Now we narrow these down to something specific. The established requirement states that the priority of assignment of the monitor authority is to be first the fixed approach control; not having this, then the control tower gets the job. Logically, this reflects that the facility most interested in IFR operations is the primary place to locate instruments associated with the monitoring aspect.

Monitors ideally need to be equipped with certain functional items. However, we need to point out that these items are not all absolute requirements since provisions have been made for their absence. The two functional items of most concern to you are the alarms and dial system. It is desirable that monitors be equipped with both aural and visual alarms. These alarms, of course, indicate malfunctions of the NAVAIDs they monitor. In the absence of both aural and visual alarms, it has been decided that the NAVAIDs must be checked at least hourly by the monitor facility. This check is accomplished by physically listening to the ID of the NAVAID over the handset or speaker provided on the monitor panel. A typical type of NAVAID monitor is shown in a later chapter on control tower equipment. The dial system is used to remotely generate various activities at the NAVAID site. For example, most NAVAIDs have two transmitters—one on the air and the other on standby. Should the on-the-air transmitter malfunction, the monitor facility can "dial up" the standby transmitter through a specifically designated number code. Other functions can also be remotely changed by the dial system, such as resetting transmitters, changing power supplies, etc. Your local facility rating should include instructions on this operation.

The monitor facility's first responsibility in the event of an interruption or malfunction of either a navigational aid or an ATC facility is to advise appropriate traffic. Next the approach/enroute facility serving the area should be notified. Other required agencies are then to be notified, and a NOTAM, if required, is sent.

EXERCISE

Complete each statement below with each of the items that follows it. Indicate whether each statement is true (T) or false (F).

6-38. Local monitoring of a navigation aid is authorized

T F a. at any time when requested by monitor personnel.

T F b. for specific reasons

6-39. When a navigational aid is in local monitor,

T F a. someone must be continuously present at the NAVAID site.

T F b. the primary monitor facility is to be advised of all transmitter malfunctions.

6-40. Reliable two-way communications are required between the NAVAID site and the primary monitor facility

T F a. whenever a NAVAID is in local monitor.

T F b. Whenever a NAVAID is "on the air."

6-41. One method of dealing with the problem of a NAVAID not being continuously monitored is to

T F a. remote the monitor to another function.

T F b. publish the unmonitored times in the appropriate flight information publication.

6-42. The priority of establishing the primary monitor facility is

T F a. tower, then fixed approach control.

T F b. first given to the facility having the greatest interest in instrument approaches.

6-43. A NAVIAD monitor having only a visual alarm should be checked

T F a. at least monthly.

T F b. by listening to the facility ID.

RANDOM AREA NAVIGATION (RNAV)

As you may have surmised, most direct route flights are military connected. The airways and routes are getting pretty crowded so a more efficient use of the airspace is needed. There is a form of navigation which is in use today although not widespread—mainly because of the lack of airborne equipment needed. However, the use of this system is growing and the terms and phraseology associated with it are starting to show up. This system provides the pilot with the capability of flying offset routes, bypassing fixes, and navigating commonly flown radar vector paths. Simplified, it is a means of navigating point-to-point that all properly equipped aircraft can use and not just high flying military aircraft. This system is called "random area navigation (RNAV)."

Learning Objective: **Match the most common terminologies related to RNAV with their respective meanings.**

Although it is a ground referenced method of navigation, RNAV is independent of exact ground stations to the extent that it does not require flight directly to or from a specific NAVAID. There are numerous types of RNAV equipment available on the market today in a variety of price ranges. The less expensive ones have only a one or two waypoint (a predetermined geographical position that is defined relative to a VORTAC station position) capability. They have no short-range correction and only limited parallel offset capability (a desired track parallel to the left or right of a designated route). Notwithstanding, these less expensive models do offer a decided advantage over conventional VOR/DME/ TACAN navigation for enroute flying in the low-altitude structure. The most expensive systems are the RNAV/Inertial combinations capable of more precise navigation by combining input data from multiple VORTACs.

It is envisioned by planners that a continued mixture of navigation (VOR/DME/TACAN and RNAV) below 18,000 feet will remain for the near future. However, those aircraft operating above 18,000 feet are required to have RNAV capability.

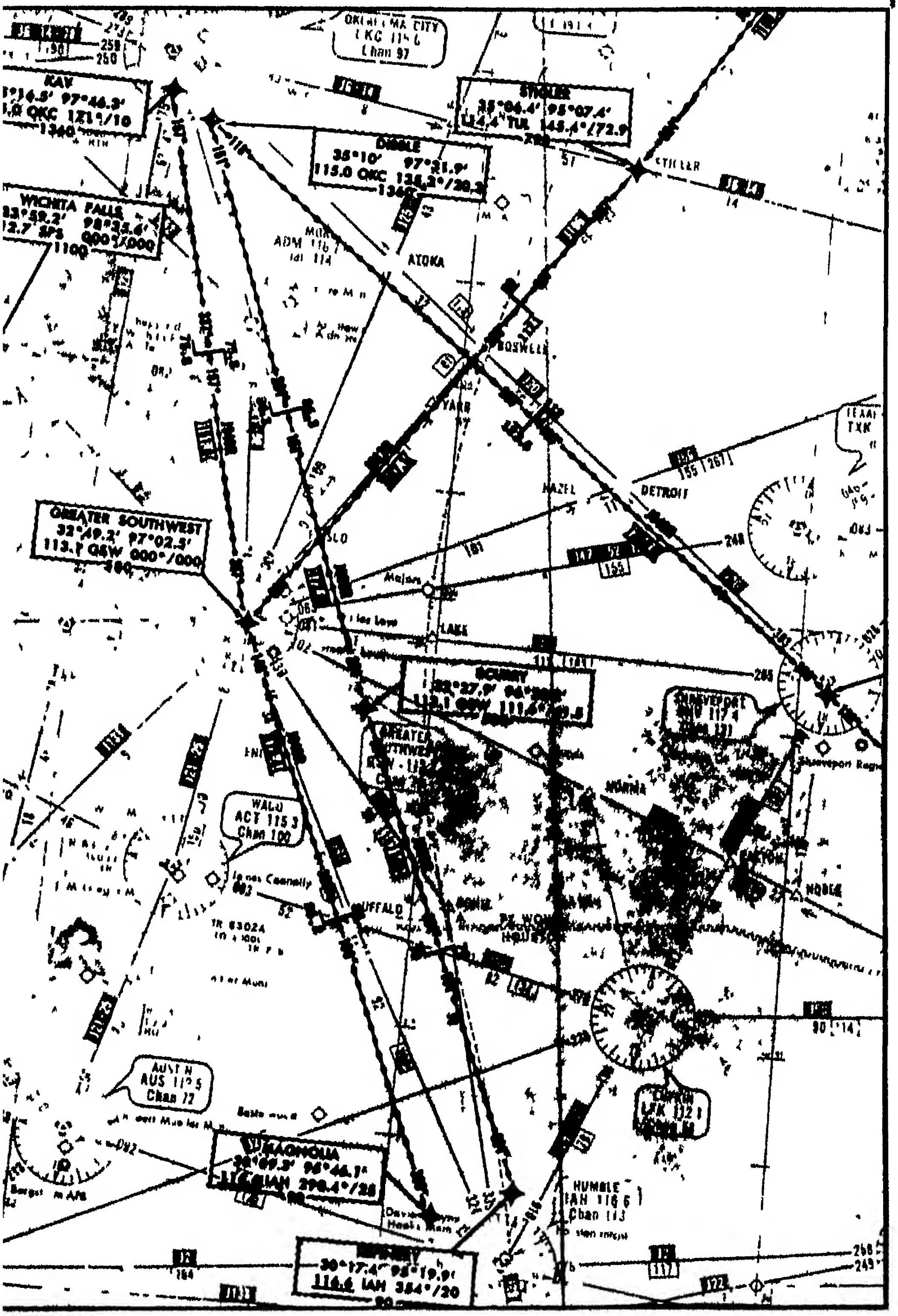
Random Area Navigation Routes (direct flight, based on area, navigation capability, between waypoints defined in terms of degree-distance fixes or offsets from published or established route or airway at a specified distance and direction) are recognizable in clearances by the word "ROMEO" being added to the airway or route number—for example, "VICTOR TWELVE ROMEO," or "J EIGHTY ONE ROMEO." We may also encounter clearances which read "OFFSET TEN MILES RIGHT/ LEFT OF J EIGHTY ONE ROMEO.

Finally, we want to show you a section of an RNAV chart. (See figure 6-42.) The RNAV routes are superimposed over the standard en route high-altitude chart. Each RNAV route segment is composed of two subsequent waypoints. Notice that the waypoints tend to be further apart than normal route fixes. They average 150 to 200 miles between waypoints. Also note that route segments do not necessarily lead directly toward or away from a NAVAID.

EXERCISE

6-44. In the space provided, match the definition in column B with the correct RNAV terminology in column A. Use each selection only once, or not at all.

COLUMN A	COLUMN B
____1. Romeo	a. A direct flight route based on area navigation capability of an aircraft.
____2. Random Area Navigation Route	b. A predetermined route segment, departure, or arrival route including SIDs and STARs.
____3. Waypoint	c. A track to the left or right of the designated route.
____4. Parallel Offset	d. A predetermined geographical position used for route definition.
	e. A word used to identify a RNAV route.
	f. A preplanned coded air traffic control IFR arrival route.



201.259

Figure 6-42.—Section from an RNAV chart.

CHAPTER 7

FLIGHT ASSISTANCE SERVICES

The importance of the assistance provided to pilots by Air Traffic Controllers assigned to the flight planning/approval branch of an Air Traffic Control Facility should be emphasized. There are countless numbers of incidents and accidents on record which could have been averted had the AC scrutinized a flight plan more thoroughly for completeness or discrepancies and relayed a particular item of importance to another airport. A careful study of this chapter and the references cited in it, coupled with close attention to detail, helps you in becoming better prepared to carry out your assigned duties in this important phase of air traffic control.

FLIGHT PLANNING BRANCH

Learning Objective: **Describe the functions of the Flight Planning Branch.**

The Flight Planning Branch of an Air Traffic Control Facility provides for planning, receiving, and processing flight plans. This branch maintains a current inventory of aeronautical charts, publications, applicable directives, Notice to Airmen (NOTAM) files, and provides facilities for aircrews to conduct flight planning.

FLIGHT PLANNING BRANCH PERSONNEL

Personnel assigned to the Flight Planning Branch are responsible for matters pertaining to flight planning, flight plan processing, and flight guard. Some of the duties and responsibilities of Flight Planning personnel include the following:

1. Procuring and maintaining required publications, directives, charts, and supplies for reference and use by pilots and branch personnel (Refer to Chapter 6 for procedures used in the procurement and maintenance of Aeronautical products)
2. Maintaining flight planning facilities and equipment
3. Disseminating and posting NOTAMs (NOTAMs are discussed later in this chapter)
4. Receiving, processing, posting and transmitting flight plans and movement messages
5. Coordinating with other air traffic control agencies and Flight Service Stations (FSS) regarding flight plans and movement messages
6. Handling incoming and outgoing communications, aircraft flight guard, and initiating overdue aircraft actions

At some Naval Air Stations the Flight Planning Branch is staffed by civilian Department of Defense (DOD) personnel. However, newly assigned Navy AC, usually undergo several weeks of indoctrination training at these stations.

FLIGHT PLANNING SECTIONS

Information on the location and size of flight planning sections and a list of the publications and equipments that should be made available to crew members is contained in the Air Traffic Control Facilities Manual, OPNAV Instruction 3721.1. In general, however, the location of the flight planning section should be convenient to the flight planning dispatcher's desk and the weather office, and should be clearly marked to guide transient

aircrews. The room or rooms assigned to flight planning must be large enough to accommodate plotting tables and storage for charts, publications, and forms required by Aircrews. Additionally, there must be sufficient wall space for the display of required aeronautical information such as:

1. A general flight planning chart
2. Local area flight planning charts of suitable scale showing VFR arrival and departure corridors
3. A scaled terrain/obstruction map, to include overlays depicting current Standard Instrument Departure (SID) courses and their proximity to known hazards
4. A NOTAM display board

FLIGHT PACKETS

Another function or service performed by flight planning personnel is the maintenance and issuance of flight packets. The purpose of a flight packet is to provide the pilot with the necessary tools (charts, approach plates, gas chits, flash lights, etc.) to complete the flight.

These flight packets (or nav kits, as they are more commonly called) are vitally important to pilots as they prepare to depart on most types of flights. However, the mission of the flight, type of aircraft used, and the geographical location of the station cause the contents of the flight packet to vary.

The following items constitute the minimum required articles to be included in flight packets:

1. Appropriate Flight Information Publications (FLIPs)
2. Navigation computer
3. Navigation Flight Log Forms
4. Appropriate aeronautical charts

Flight packets are maintained in the Flight Planning/Approval Branch for station aircraft only; that is, aircraft for which the station commanding officer is reporting custodian or for which he has responsibility. Squadrons, units, etc., based at the facility maintain their own flight packets for their use.

Normally, the pilot or a representative of the flight crew stops at the flight planning room to obtain a flight packet prior to preparing the flight plan. Figure 7-1 is a sample flight packet checklist. This form can be expanded or shortened to meet the needs of the station. The pilot or crew representative, when presented one of these forms, fills out the top portion. Then the AC can quickly assemble those items that the pilot has indicated as being required for the particular flight.

A checklist such as shown in figure 7-1 not only allows the pilot to select the items deemed necessary for the flight but also greatly reduces the chance of an item being left out. In addition, the form serves as a temporary custody receipt. This is very important, as the value of the items that might be included in a flight packet may vary from a few dollars to several hundred dollars.

FLIGHT PLANNING/APPROVAL BRANCH LOGS AND RECORDS

As you can see the flight approval office is the central point for processing aircraft movement and related messages. This office must maintain various records, logs, and files connected with air operations. Examples of information on file include SCANTANA actions forms, which were discussed in chapter 2, Facility License for civilian aircraft, VIP notification procedures, telephone numbers of other departments that furnish services required by transient aircrews, FLIPs, and FAA publications required in daily functions. Examples of records kept are flight plans (DD Form 175s) filed with flight clearance, flight progress strips, and teletype messages.

Duty Dispatcher's Log

The duty dispatcher's log is maintained at the flight approval desk from watch to watch. Personnel assuming the watch enter in the log their name, the date, and time the watch is being performed. Examples of entries made in such a log are crash phone checks, time checks, intercommunications checks, and any other data pertinent to operations that transpire during the watch.

Pass Down The Line (PDL)

This type of log may be maintained for the purpose of passing instructions from crew to crew to ensure that night crews have access to

NAVKIT/FLIGHT PACKET RECEIPT
CNATRA-GEN 3710/3 (Rev. 8-69)

		ISSUED BY FRENCH, R	PACKET NO. 9
PILOT'S NAME BELL, W.R.	RANK LCDR	UNIT ATTACHED NAS / PHONE 366	DATE 6-25-83

NAVIGATION KIT			MISCELLANEOUS EQUIPMENT		
ITEM	OUT	IN	ITEM	OUT	IN
ENROUTE SUPPLEMENT IFR VFR	✓		WEIGHT AND BALANCE BOOK		
ENROUTE HI/LO ALTITUDE CHART	✓		LOAD ADJUSTER		
AREA ARRIVAL CHARTS			COMPUTER	✓	
APPROACH PROC. NEUS			PLOTTER		
APPROACH PROC. SEUS	✓		DIVIDER SET		
APPROACH PROC. NWUS			CHRONOMETER		
APPROACH PROC. SWUS			SEXTANT		
AERODROME SKETCHES			FLASHLIGHT	✓	
FOREIGN FLIP SET HI/LO			IFR HOOD		
			PENCILS	✓	
			UNSAT MATERIAL REPORT (UR) NAVAIR FORM 13070/5		

PROCUREMENT DOCUMENTS

DD FORM 1348		DD FORM 1149		STANDARD FORM 44	
NUMBER	USED	NUMBER	USED	NUMBER	USED
309871				1256031	
309872				1256032	
309873					

TO BE COMPLETED BY PILOT *(If any of above listed documents used)*

The procurement documents checked above were used and copies are attached. Unless otherwise indicated below, no other obligations were incurred by me during the period from ____________________ to ____________________.

PILOT'S SIGNATURE	DATE

201.91

Figure 7-1.—Flight packet checklist.

information, etc. put out by the branch officer/supervisor. Also it may be used to relay local verbal standing or temporary orders issued by the division or operations officer. It is generally an informal type of log strictly for the purpose of getting the word to everyone.

FLIGHT DATA AND STATUS BOARDS

To reduce the constant answering in the flight approval office of questions from the general public, flight data and status boards are useful tools to the Air Traffic Controller. The actual size, shape, and construction, as well as the manner in which the information is portrayed, undoubtedly may vary from station to station. However, the information normally displayed on the flight data board for inbound flights is as follows:

1. Bureau number.
2. Type of aircraft.
3. Point of departure.
4. ETA.
5. Pertinent remarks.

Status boards are usually of the type which shows the present status of the various navigational aids at the particular station. It is also possible that an additional status board may be maintained by the AC at stations assigned aircraft for search and rescue purposes. This type of status board normally contains information as to the flight status of the aircraft assigned and pertinent information concerning the crew.

Status boards may be maintained in a radar facility control room showing the area of responsibility and adjoining airspace, airways and jet routes, SIDs, fixes, handoff points, holding points and holding pattern airspace areas, and the published approaches available for reference at operating positions.

When assigned the duty of maintaining any status board, remember that the information is important and should be kept neat, accurate, and current at all times.

EXERCISE

7-1. What is the main function of the Flight Planning Branch?

7-2. At an Air Traffic Control Facility, who normally initiates overdue aircraft actions?

7-3. What Navy Publication would you refer to for information on the location and staffing of Flight Planning?

7-4. What is the purpose of a flight packet?

FLIGHT HANDLING

Learning Objective: **Recognize pilot responsibility, and assistance the AC provides to the pilot in planning a flight.**

The pilot in command of a flight is responsible for assuring that the appropriate flight service agency is furnished with the essential elements of the flight plan and a takeoff report. Delivery of a properly prepared flight plan form to duty personnel at an established flight planning (base operations) office at the point of departure relieves the pilot of such responsibility. The local Flight Planning Supervisor must then ensure that the appropriate flight service agency is furnished the flight plan and takeoff report by duty personnel upon acceptance of the flight plan form.

The pilot in command is also responsible for assuring that the appropriate flight service agency is furnished a landing report (closeout) upon arrival at the destination. Delivery of a copy

of an executed flight plan form to the destination flight planning or base operations duty personnel satisfies this responsibility. The local Flight Planning Supervisor must then ensure that duty personnel furnish the appropriate flight service agency with the landing report upon acceptance of the flight plan form.

PREFLIGHT PLANNING BY PILOTS

OPNAV Instruction 3710.7 (Series) states that: "Before commencing a flight, the pilot in command shall familiarize himself with all available information appropriate to the intended operation. This information should include but is not limited to available weather reports and forecasts, NOTAM, fuel requirements, alternatives available if the flight cannot be completed as planned, and any anticipated traffic delays."

The pilot in command of a naval aircraft, or group of aircraft proceeding as a unit, must prepare and submit to the local ATC Facility a flight plan appropriate for the intended operation except:

1. Flights of urgent military necessity.
2. Student training flights under the jurisdiction of the Naval Air Training Command for which adequate flight guard is provided.

Although the overall responsibility for preflight planning rests with the pilot in command, you as an Air Traffic Controller, as has been previously noted, share in this responsibility. In addition to ensuring that charts and publications are up to date and available for the pilot's use, you must remain abreast of recent changes which affect the safety of flight.

FLIGHT PLAN FORMS

DD Form 175

The DD Form 175 Military Flight Plan (figure 7-2) must be used for all flights within the North American (NAM) Region and the Honolulu and Sun Juan domestic control areas. The NAM Region includes the Continental U.S. and Canada to the North Pole.

NOTE: Flights departing from U.S. installations not having a military base operations facility may use FAA Flight Plan Form 7233-1.

Instructions for completing the DD Form 175 are contained in the FLIP Planning, General Planning section.

The purpose of the flight plan is to relay the desires of the pilot to air traffic control personnel. The information on the flight plan form is also extremely helpful to the AC in the event that an aircraft becomes lost or overdue. For example, the number and type of aircraft, the proposed route of flight, and the fuel on board are contained on the form.

DD Form 175-1 (Flight Weather Briefing)

This form is not used as a flight plan by pilots, but since it is so closely associated with the planning phase of flight it is discussed at this time.

1. GENERAL. Pilots are responsible for reviewing and being familiar with weather conditions for the area in which the flight is contemplated. Where naval weather services are available, weather briefings shall be conducted by a qualified meteorological forecaster. They may be conducted in person or by telephonic, autographic, or weathervision means.

2. FLIGHT WEATHER BRIEFING FORM. A DD Form 175-1, Flight Weather Briefing (figure 7-3), shall be completed for all flights to be conducted in accordance with instrument flight rules, when military weather services are available. The forecaster shall complete the form for briefings conducted in person and for autographic briefings. It is the pilot's responsibility to complete the form for telephonic or weathervision briefings. For VFR flights using the DD-175, the following certification on the flight plan may be used in lieu of a completed DD Form 175-1:

BRIEFING VOID ________Z, FLIGHT AS PLANNED CAN BE CONDUCTED UNDER VISUAL FLIGHT RULES. VERBAL BRIEFING GIVEN AND HAZARDS EXPLAINED.

____
(Signature of forecaster)

MILITARY FLIGHT PLAN	AIRCRAFT UNIT OF ASSIGNMENT/HOME STATION	AIRCRAFT SERIAL NO
	NQA	133157

TYPE OF FLIGHT PLAN	RADIO CALL	AIRCRAFT DESIGNATION/TO CODE	ESTIMATED TRUE AIRSPEED	DEPARTURE TIME (Z) PROPOSED	DEPARTURE TIME (Z) ACTUAL
☑ IFR ☐ DVFR ☐ VFR ☐ FVFR	VV4M157	TS-2 A/B	170	0800	0805

INITIAL CRUISING ALTITUDE	POINT OF DEPARTURE	STANDARD INSTRUMENT DEPARTURE: NAME AND NUMBER	STANDARD INSTRUMENT DEPARTURE: TO
10,000	NQA	RADAR VECTORS	MEM

IFR	VFR	ROUTE OF FLIGHT	TO	ETE
✓		→ MEM V9 JAN V11 MOB		
		V242 BFM V198 NUN	NPA	2+25
✓		170 80 NUN V198 BFM		
		V242 MOB V11 JAN		
		V9 MEM (5+30 BYH 0+18)	NQA	2+40

REMARKS: ONE HOUR DELAY NPA TO REFUEL

RANK/HONOR CODE	PSGR/CARGO CODE
	M4 VOID 6+00

HOURS FUEL ON BOARD	DIST TO DESTN	ALTERNATE AIR FIELD	ETE TO ALTN	NOTAMS	DD FORM 365F (Wt. and Bal.)	WEATHER	REQUEST CLEARANCE AFTER
5+30	382	NAS WHITING	0+20	✓	FILED NQA	✓	0745

INST RATING	SIGNATURE OF PILOT IN COMMAND	SIGNATURE OF APPROVING AUTHORITY	DATE
SPECIAL	WR Bell	WR Bell	11 MAR 83

CREW/PASSENGER LIST — ☐ Attached ☐ See Passenger Manifest

DUTY	NAME AND INITIALS	GRADE	SERVICE NO.	ORGANIZATION AND LOCATION
PILOT IN COMMAND	BELL, W.R.	LCDR	518286	NTPC/NQA
C.P.	BUDREJKO, D.S.	LTJG.	754162	NTPC/NQA
	BAYER, N.C.	ACCS	2807937	NTPC/NQA
	McCOY, J.D.	YNC	2297807	NTPC/NQA

DD FORM 1 JUL 65 175 PREVIOUS EDITION OF THIS FORM WILL BE USED UNTIL STOCK IS EXHAUSTED. 0102-001-6500

201.4

Figure 7-2.—DD Form 175.

FLIGHT WEATHER BRIEFING

MISSION

ETD	DEST/ETA	ALTN/ETA	BRIEFING NO.	DATE	ACFT/NUMBER
0 Z	1405 Z	1425 Z	140	11 MAR 1983	133157

TAKEOFF DATA

RWY TEMP	DEWPOINT	SFC WIND	TEMP DEV	PRESSURE ALT	DENSITY ALT	RCR
16 °C	12 °C	2912	0 °C	+92 FT	FT	

WINDS 270/14

LOCAL WEA WARNING OR MET WATCH ADVISORY

RKS/TAKEOFF ALTN FCST

ENROUTE DATA

LEVEL 10,000

FLT LEVEL WINDS/TEMP 270/30 −8°C

S AT FLT LEVEL: S ☐ NO ☐ IN AND OUT

MINIMUM VISIBILITY AT FLT LEVEL OUTSIDE CLOUDS 5-7 MILES, DUE TO ☐ SMOKE ☐ DUST ☐ HAZE ☐ FOG ☑ PRECIPITATION ☐ NO OBSTRUCTION

IUM CEILING	LOCATION	MAXIMUM CLOUDS TOPS	LOCATION	MINIMUM FREEZING LEVEL	LOCATION
00 FT AGL	JAN	15,000 FT MSL	JAN-CBM	7000 FT MSL	JAN

THUNDERSTORMS (in fifty miles of route)	TURBULENCE (within ten miles of route not associated with TSTMS)			ICING (within ten miles of route not associated with TSTMS)				PRECIPITATION (within ten miles of route not associated with TSTMS)				
NO.	CAT ADVISORY Z			NONE				NONE				
NE / AREA / LINE	NONE	IN CLEAR	IN CLOUD		RIME	MIXED	CLEAR		DRIZ	RAIN	SNOW	SLEET
OLATED 1-2%	LIGHT	✓		TRACE				LIGHT				
W 3-15%	MOD			LIGHT	✓			MOD		✓		
ATTERED 16-45%	SVR			MOD				HEAVY				
MEROUS-MORE THAN 45%	EXTREME			SVR				SHWRS		✓		
SVR TURB, SEVERE ICING, RECIPITATION EXPECTED IN EAR TSTMS	LEVELS 8000 - 9000			LEVELS 9000				FRZG				
ION	LOCATION JAN - BFM			LOCATION NPA				LOCATION NPA				

TERMINAL FORECASTS

NATION	CLOUD LAYERS	VIS/WEA	SFC WIND	ALTIMETER	VALID TIME
QA	25 ⦶ 100 ⊕	7	2406	2992 INS	1305 Z TO 1505 Z
NATE SE	22 ⦶ 70 ⊕	4RW-	2108	2995 INS	0945 Z TO 1145 Z
D STOP DA	25 ⦶ 80 ⊕	5 RW-	2210	2994 INS	0925 Z TO 1125 Z
D STOP				INS	Z TO Z

COMMENTS/REMARKS

BRIEFING RECORD

ED ON LATEST RCR FOR DEST AND ALTN ☑ YES ☐ NOT AVAILABLE		VOID TIME 0830 Z
ST PIREP AT		EXTENDED TO Z
LIMSY NO. / WEA BRIEFED 0700 Z	FORECASTER'S SIGNATURE AG1 J.D. Shelton	WEA REBRIEFED AT Z / FORECASTER'S INITIALS
CLTY / TAPE NO. / START Z / STOP Z	PHONE CHARGE	NAME OF PERSON RECEIVING BRIEFING

FORM JUN 70 175-1 PREVIOUS EDITION WILL BE USED. S/N 0102-001-6701

201.5

Figure 7-3.—DD Form 175-1.

ACs should assist pilots in ensuring that the weather briefing is still valid at takeoff. The weather briefing void time is normally one-half hour after estimated time of departure (ETD). Except under unusual circumstances, this should not exceed two hours from the actual time of weather entries on the DD Form 175-1. Methods of checking weather briefing void times vary between facilities, but most require that the void time be included on the flight progress strips used to maintain a file of current air operations. The flight progress strips are discussed later in this chapter.

Daily Flight Schedule/ Abbreviated DD Form 175

Approval authorities may authorize the use of the daily flight schedule or an abbreviated DD Form 175 signed by the pilot in command, with the word LOCAL contained in the route of flight block, for clearing aircraft for flight within the established local flying area and adjacent offshore training areas provided the following conditions apply:

1. Sufficient information is included to satisfy the needs of the local facility which guards the flight.
2. Base operations maintains cognizance of each flight and is responsible for initiating any overdue action or in-flight advisory service necessary.
3. Completed flight schedules are retained in base operations files for three months.
4. Flights are not conducted IFR within controlled airspace except as jointly agreed upon in writing between the local command and the air traffic control agency concerned.

DD Form 1801—DOD International Flight Plan

DD Form 1801 is used for flights planning to operate in international airspace in accordance with International Civil Aviation Organization (ICAO) rules.

This flight plan is used when the flight originates within the North American Region (NAM) and proceeds nonstop beyond the NAM region and for all other flights outside of the NAM region.

Detailed information pertaining to the DD Form 1801 and ICAO flight plans is contained in FLIP Planning, General Planning Section.

Handling of Flight Plan Forms

Approval of flight plans for aircraft of other military services must be in accordance with the individual service directives for those aircraft. FAA regulations are used to govern approval of flight plans for civil aircraft.

The concurrence of the pilot in command is required prior to any modification of a written flight plan form.

It should be noted that copies of the flight plan and weather forms must be retained on file at the point of departure for three months; the same applies for copies of these forms turned in at the point of landing. If a flight plan is filed at a civilian airport, the FAA will hold the flight plan for 15 days and then forward it to the home station of the aircraft.

STOPOVER FLIGHT PLANS

Flights which involve en route stops within the United States are authorized to utilize a single DD Form 175, provided the following procedures are followed:

1. The DD Form 175 is prepared in accordance with the applicable instruction contained in the FLIP (Planning).
2. A weather and NOTAM briefing for the planned route of flight is obtained. Weather data entered on the DD Form 175-1 must indicate forecast conditions for each leg of the flight, destination, and each alternate (if required). In addition, pilots are required to maintain a check as necessary to ascertain if an aviation severe weather forecast (WW) has developed or is forecast along the proposed route of flight.
3. Ensure that the weather at each point of intended landing and the alternate (if required) is equal to or better than the minima prescribed in OPNAV Instruction 3710.7 (Series).
4. No change of the pilot in command of the aircraft as originally filed is made.
5. When a change of passengers or crew occurs, a corrected manifest must be available at the en route station where the change takes place.

6. Weight and balance requirements are adhered to.

7. When conducting IFR Operations after the first leg of flight, the pilot must notify the Flight Service Station (FSS) serving the next stopover point of his ETD from that field.

8. The pilot must obtain an IFR clearance from ATC at each stopover point if one is required.

9. A revised flight plan VOID time must be filed with the appropriate FSS if required.

NOTE: For all stopover flights, a VOID time is entered in remarks. Such VOID times are computed by adding the ETE for each leg of the flight and the total estimated ground time for all stopovers to the ETD as entered on the flight plan; e.g., "VOID 6+05."

10. In the event the flight is terminated at an intermediate base, the pilot is required to ensure that the balance of the original flight plan is closed out.

With regard to item 6 concerning Stopover Flight Plans, although ACs normally are not concerned with the weight and balance requirements for military aircraft, a brief description of the pilot's responsibility in this vital area is included to acquaint you with this requirement.

Requirements for aircraft weight and balance control are contained in NAVAIRSYSCOM Instruction 13060.2 (Series) and the NATOPS Flight Manual for the particular type aircraft involved. These directives specify the maximum operating weights, center of gravity limitations, and restrictions.

Aircraft are classed as 1A and 1B (attack, fighter, and trainer) with the majority of patrol and cargo aircraft being classed as 2. The responsibility for ensuring safe loading of class 1A and class 1B rests with the reporting custodians.

The pilot in command of a class 2 aircraft certifies by his signature on the DD Form 175 that the aircraft's weight and center of gravity will be within safe limits at the time of takeoff and remain so for the duration of the flight. The pilot may either submit a completed weight and balance form, DD Form 365F (figure 7-4), which represents the actual loading of the aircraft with the DD Form 175 or, certify (with a signature) that a completed DD Form 365F, dated within the previous three months and which represents the actual loading of the aircraft, is on file at the aircraft's home base.

When a DD Form 365F is filed with the approval authority it should be retained for a period of three months.

SHORE/SHIP OPERATIONS

The pilot in command must file a flight plan prior to a flight from a shore activity to a ship operating in an offshore area when a landing aboard the ship is intended. A DD Form 175 is required for an IFR flight. A daily flight schedule or abbreviated DD Form 175 may be used for a VFR flight.

Prior to flight from a ship operating in an offshore area to a shore activity where a landing is intended, the pilot in command must file a flight plan with the ship. The ship relays the flight plan (by message) to the shore activity. If no communications link is available, the pilot should file a flight plan with the nearest shore activity by radio as soon as possible after takeoff.

Clearing authorities and, subsequently, duty personnel at base operations, are responsible for ensuring timely handling of flight movement information for each ship/shore operation.

Flight suspense for search and rescue purposes becomes the responsibility of the destination activity after acknowledging receipt of a flight plan.

When such flights will penetrate or operate within an ADIZ or DEWIZ (discussed in chapter 2 and Appendix D) the appropriate air defense command must also be informed of the operation.

FLIGHT PLAN CODES

Various codes are established concerning the highest rank aboard, VIP (Very Important Person) honors requested, and cargo/passenger control information. This information is contained in the remarks section of a DD Form 175. (See figure 7-2.) ACs are responsible for ensuring that timely action is effected and appropriate personnel are made aware of such information.

WEIGHT AND BALANCE CLEARANCE FORM F
TACTICAL
(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN T O 1-1B-40 & AN 01-1B-40

DATE	AIRPLANE TYPE	FROM	HOME STATION
4 APRIL 1983	SP-2H	NQA	NQA
MISSION/TRIP/FLIGHT/NO.	SERIAL NO. 144681	TO PNA	PILOT W.R. BELL

REMARKS

REF	ITEM	WEIGHT	[1] INDEX OR MOM/
1	BASIC AIRPLANE (From Chart C)	53919	830
2	OIL (120 Gal)	1200	838
3	DISTRIBUTION OF LOAD		

COMPT	CREW NO	CREW WEIGHT	BAGGAGE	CARGO AND MISC	WEIGHT	INDEX OR MOM/
B	3	200 ea			600	701
C	5	200 ea	100		1100	551
D	3	200 ea			600	585
E			300			639

COMPUTER PLATE NO. *(If used)*

Pertinent instructions to the pilot for shifting load and crew during takeoff and landing should be noted above

CORRECTIONS *(Ref 11)*

COMPT	ITEM	CHANGES (+ or –) WEIGHT	[1] INDEX OR MOM/
TOTAL WEIGHT REMOVED		–	–
TOTAL WEIGHT ADDED		+	+
NET DIFFERENCE *(Ref. 11)*			

LIMITATIONS

[2] GROSS WT. TAKEOFF *(lb.)*	[2] GROSS WT LANDING *(lb.)*	
[3] PERMISSIBLE C. G TAKEOFF	FROM	TO *(% M. A. C. or IN.)*
[4] PERMISSIBLE C. G. LANDING	FROM	TO *(% M. A. C. or IN.)*

REF	ITEM	WEIGHT	INDEX OR MOM/
4	OPERATING WEIGHT	57419	639
5	AMMUNITION: COMPT / ROUNDS / CALIBER		
6	BOMBS, ROCKETS, ETC.: FORWARD		
	SONOS – 60	900	839
	AFT PDC – 50	250	891
	EXTERNAL		
	ROCKETS		
7	FUEL: BUILT IN (Gal.)	13680	890
	BOMB BAY (Gal.)		
	EXTERNAL (Gal.)		
8	WATER INJ FLUID (Gal.)	375	868
9	JATO OR RATO		
10	TAKEOFF CONDITION *(Uncorrected)*	72624	868
11	CORRECTIONS *(If required)*		
12	TAKEOFF CONDITION *(Corrected)*		
13	TAKEOFF C. G IN % M. A. C. OR IN.	31.1%	
14	LESS EXPENDABLES: JATO OR RATO		
	BOMBS		
	AMMUNITION		
	FUEL	11000	879
15	ESTIMATED LANDING CONDITION	61624	879
16	ESTIMATED LANDING C. G. IN % M. A. C. OR IN.	29.9%	

[1] *Enter constant used.*
[2] *Enter values from current applicable T. O.*
[3] *Applicable to gross weight (Ref 12).*
[4] *Applicable to gross weight (Ref. 15).*

COMPUTED BY *(Signature)* AN3 D.E. Pennid
WEIGHT AND BALANCE AUTHORITY *(Signature)* CDR J.O. Landaker
PILOT *(Signature)* LCDR W.R. Bell

DD FORM 1 SEPT 54 365F

Figure 7-4.—DD Form 365F.

Since these codes are quite lengthy, only a partial listing of them is presented in this training manual. You should refer to a current edition of Flight Information Publication, General Planning, Section II, for accurate and complete information contained in flight plan codes. OPNAVINST 3722.8 (Series) is also a good reference for flight plan codes.

Flight Plan VIP Codes

The VIP code in the remarks section of the DD Form 175 contains a letter indicating the branch of service, a number code for the highest rank or grade aboard, and another letter which indicates what, if any, honors the VIP desires. The following section is a partial listing of these codes.

SERVICE CATEGORY DESIGNATORS

Designator	Category
1. A	Air Force
2. R	Army
3. C	Coast Guard
4. M	Marine Corps
5. V	Navy
6. S	Civilian
7. F	Foreign Civilian or Military

VIP CODES

Code	Meaning
1. 1 -	President of the U.S. Ex-President of the U.S.
2. 2 -	Vice President Governor of states Cabinet members CNO Chiefs of Staff USAF and Army Secretary of the Navy Fleet Admiral (5 star)
3. 3 -	Special Assistant to the President Under Secretaries Generals and Admirals (4 star)
4. 4 -	Lt Generals and Vice Admirals (3 star)
5. 5 -	Major Generals and Rear Admirals (Upper Half) (2 star)
6. 6 -	Brigadier Generals and Rear Admirals (Lower Half) (2 star)
7. 7 -	Captains, USN and USCG—Colonels, USMC/USAF, USA

(NOTE: This is a partial listing; the complete list is in FLIP Planning General Planning Section.)

HONOR CODES

Code	Meaning
1. H -	Accord Honors
2. N -	Accord no Honors: request informal visit with the Commander
3. O -	Request nothing

EXAMPLES:

V5H -	VIP5 Navy Rear Admiral, accord honors
V7O -	VIP7 Navy Captain, request nothing
R5O -	VIP5 Army Major General, request nothing
A3N -	VIP3 Air Force General, accord no honors; request informal visit with the Commander

Service, Passenger, and Cargo Codes

The service, passenger, and cargo codes are used by pilots to indicate what servicing is required at the destination airport and whether or not passengers and/or cargo can be accepted or will

be off-loaded. The following list contains some of these codes, their meanings, and examples.

Code	Meaning
1. S	Servicing required
2. T	Transportation required

Example: T20 means, require transportation for 20 passengers.

3. Q Quarters needed

Example: Q6M-2F/16M-1F means, require quarters for 6 male and 2 female officers and 16 male and 1 female enlisted personnel. If there were no officers requiring quarters, the first numbers (6 and 2) would be dropped but the slant would be retained. For example: Q/16M-1F.

4. M Meals required

Example: M5 indicates meals for five personnel are required.

5. R The aircraft will remain overnight (RON) at the destination. R2 means the aircraft will RON two nights.

6. DC The aircraft will off-load cargo at the destination. The last two digits of the amount are dropped.

7. AC The aircraft can accept cargo.

Example: DC4 indicates the aircraft will discharge 400 pounds of cargo, DC40 means the aircraft will discharge 4000 pounds, and DC40AC50 indicates the aircraft will discharge 4000 pounds and can accept 5000 pounds of cargo.

8. DP The aircraft will discharge passengers.

9. AP The aircraft can accept passengers.

10. PU The aircraft will pick up prearranged passengers.

11. NP The aircraft needs additional parachutes. If parachutes are not required by regulations, this information will be deleted.

Example: DP7PU6AP4NP3 means, the aircraft will discharge seven passengers, will pick up six prearranged passengers, and can accept four additional passengers if three of them have parachutes.

RELAY OF FLIGHT DATA

A Flight Service Station (FSS) is a facility within the National Airspace System (NAS) having the prime responsibility for en route communications with VFR flights, assisting lost VFR aircraft, and accepting and closing flight plans.

Services that FSSs provide, in addition to the services already mentioned, are the dissemination of civilian Notices to Airmen (NOTAM), assisting in the search for missing VFR aircraft, and operating the national teletypewriter systems.

An agreement between the FAA and Department of Defense (DOD) provides that the FAA assume certain communications functions dealing with military flight plans and related messages. Designated FSSs, called tie-in stations, are connected to adjacent military bases' Flight Planning Branches, base operations (BASE OPS), by local interphone for handling traffic. This does not include flights to or from carriers, which are handled via Navy communications.

Interphone (telephone) and teletypewriter lines used to process flight plan data and control messages are usually provided at military BASE OPS within the Continental U.S. (CONUS) by the FAA or by a commercial utility company on a rental basis.

The FAA uses two interphone systems for the purpose of rapid voice communications. Service F is an interphone system which connects Air Route Traffic Control Centers (ARTCCs) and associated terminal facilities for handling IFR movement and control messages which are time-critical. Flight Service Interphone is the landline connection between tie-in stations and adjacent military bases to handle messages between such stations.

The FAA uses a teletype system called Service B to handle communications requirements of aircraft movement and control messages. The system consists of two separate teletype networks, Area B and Center B. Area B circuits are generally arranged to serve ARTCC areas in CONUS. All FSSs are on an Area B circuit and those FSSs designated as tie-in stations may actually enter military messages on the FAA teletype circuit for adjacent military bases. ARTCCs use Center B to handle emergency and IFR movements and control messages addressed to other centers.

A related circuit, called Utility B, connects most military base operations with ARTCCs for transmitting proposed IFR flight plans.

Equipment and procedures for transmitting IFR flight plans via teletype may vary at different ATC facilities. However, required items of information to be relayed are normally standard.

An example of a proposed IFR flight plan teletype message, utilizing the data contained in the sample DD Form 175 (figure 7-2) is as follows:

ZEM MEM 0715121 FP VV4M157 TS-2A/B
0170 NQA P0800 100 NQA V9 JAN V11
MOB V242 BFM V198 NUN NPA

FLIGHT PROGRESS STRIPS

Flight progress strips are used to post current data on air traffic and clearances required for air traffic control and air traffic services. Terminal facilities providing approach control service must use the flight progress strips as listed in FAA Handbook 7110.65 (Series). At some locations these strips are also used in the tower and flight planning/approval branches for recording data in a manner prescribed locally. Our discussion of flight progress strips centers around FAA Forms 7230-7 and 7230-8. Both forms are used in Navy air traffic control facilities.

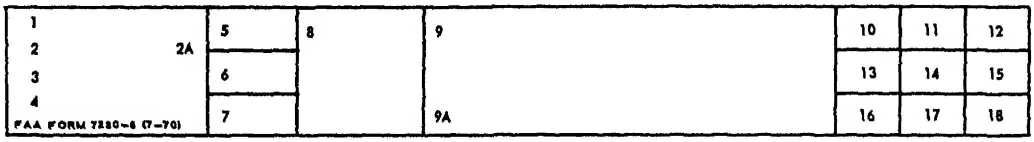
Entries on the flight progress strips present a picture of arriving, departing, and en route IFR traffic. Navy flight progress reports on departures, arrivals, and overflights are posted on FAA Form 7230-7 in approach control facilities equipped with the Flight Data Entry and Printout (FDEP) system. By use of a computer, FDEP automates the computation and transmission of flight plan and movement data between the FAA's Air Route Traffic Control Centers (ARTCCs) and control towers and approach controls. Using the FDEP system, flight plan clearance information is automatically transmitted via teletype circuits from the ARTCC to the tower or approach control where flight-strip printers automatically print out data on the flight progress strip. Alphanumeric keyboards are located in the tower or approach control for use by controllers to automatically transmit flight progress data to the ARTCC. This system not only permits controllers to receive and transmit aircraft flight plan information automatically, but provides a quicker and more simplified exchange of data. This reduces the possibilities of human error during the relay of essential clearance information.

FAA Form 7230-8, a manual flight progress strip, is also used in Navy towers and approach controls. Although it eventually will be replaced by the FAA Form 7230-7, it is the primary flight progress strip used for departures, arrivals, and overflights in facilities not equipped with FDEP. The strip format conforms to the format of the machine-generated strip, and data entries, as applicable, are identical.

FAA Form 7230-8 is represented in figure 7-5. As there is no difference in the format of this strip and FAA Form 7230-7, we are limiting further discussion to the manual strip. First, we use this flight progress strip to post pertinent information relating to departing IFR aircraft. The top portion of figure 7-5 shows a blank flight progress strip on which we have numbered the different sections. Immediately below the blank strip are the items of information that are posted on the strip. Each item has been numbered to correspond to the section on the strip where it will be posted. For example, item 1, aircraft identification, is posted in section 1. A close check of the numbered sections and information in them shows you that only information that concerns the flight is posted on the strip. Shown in the lower portion of the figure is an example of a posted departure strip.

FAA Form 7230-8 is also used for manually posting information about arriving IFR aircraft. An example of this usage is shown in figure 7-6. As in figure 7-5, the numbered items below the top strip correspond to the sections of the strip where the items are entered. Only the information applicable to the aircraft is posted on the strip. Normally, if you are working in a terminal radar facility, you may omit entering information in sections 8 through 18. However, this information must be posted, as specified by facility memoranda, when your recorder equipment fails or when you use nonradar control procedures.

When traffic conditions warrant, your facility officer may change the format of the flight progress strips, but the information posted on the strips must always be complete enough for you to comply with FAA Procedures. Flight progress strips are used at some locations for recording VFR information in control towers. Flight progress reports are posted directly on the



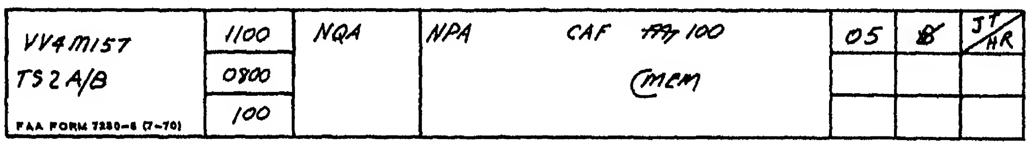
DEPARTURE ENTRIES:

1. Aircraft identification.
2. Revision number (FDEP locations only).
2A. Strip request originator. (At FDEP locations this indicates the sector or position that requested a strip be printed.)
3. Number of aircraft, if more than one, heavy aircraft indicator "H/" when needed, type of aircraft and suffix indicating any special equipment.
4. Computer identification number.
5. Secondary radar (beacon) code assigned.
6. Proposed departure time.
7. Requested altitude.
8. Departure airport.
9. Machine generated - Route, destination and remarks. Manually enter altitude and/or altitude restrictions in the order flown, if appropriate.

   Manually prepared - Clearance limit, route, altitude and/or altitude restrictions in the order flown, if appropriate, and remarks.

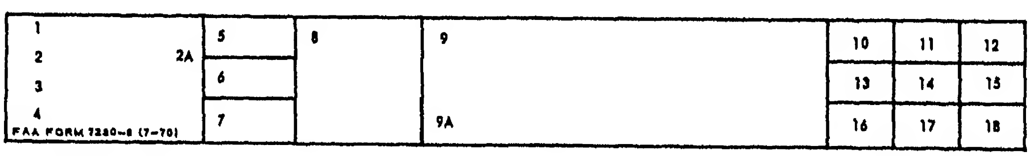
9A. Not used.

10 through 18. Enter data as specified by local Facility Directive.



201.251

Figure 7-5.—FAA Form 7230-8 Manual Flight Progress Strip (Departure).

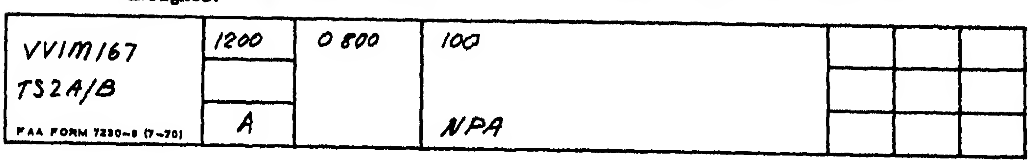


ARRIVAL ENTRIES:

1. Aircraft identification.
2. Revision number (FDEP locations only).
2A. Strip request originator. (At FDEP locations this indicates the sector or position that requested a strip be printed.)
3. Number of aircraft, if more than one, heavy aircraft indicator "H/" when needed, type of aircraft and suffix
4. Computer identification number, if required.
5. Secondary radar (beacon) code assigned.
6. Previous fix (FDEP locations) or inbound airway.
7. Coordination fix. (May be a handoff point or for terminal facilities may be used to indicate a clearance limit.)
8. Estimated time of arrival at the coordination fix or destination airport.
9. Altitude (in hundreds of feet) and remarks.

9A. Destination airport.

10 through 18. Enter data as specified by local Facility Directive.



201.252

Figure 7-6.—FAA Form 7230-8 Manual Flight Progress Strip (Arrival).

ppropriate flight progress strips. The strips are ;quenced in order of arrival over a particular fix ime sequence), or arranged according to altitude :vels (altitude sequence). Strips may also be ;gregated according to arrivals or departures and ;quenced in the same bay of the flight progress oard. When arrival and departure strips are ;quenced in the same bay, they must be separated ito two groups. At some facilities, different color .rips are used for this purpose. Make notations n the strips concerning the progress of each ircraft until it lands or is released from your ontrol.

Post data on flight progress strips in ink or encil. When you must correct or revise posted ems, draw a single horizontal line through the em. The correct item or revision is then made y putting it adjacent to your correction in the ame section (space). DO NOT MAKE ERAS-JRES ON FLIGHT PROGRESS STRIPS!)raw a line through an assigned altitude only after ou receive a report that the aircraft has vacated ıat altitude.

The control symbology and abbreviations used or posting data on flight progress strips change requently; however we have included some of the ıore common ones in this manual. To insure that ou post data correctly, you must refer to the ıtest procedures contained in FAA Handbook 110.65. In addition, your facility officer may repare letter codes for intrafacility use for avigational aids (fixes) when they have not been ssigned national identification codes. However, uch codes can be used only within the facility.)o not use the intrafacility codes on teletypewriter r interphone circuits.

ecording Flight Data

As previously stated, only authorized control nformation symbols, abbreviations, and phrase ontractions should be used for recording position eports, air traffic clearances, and instructions on light progress strips. Plain language, abbrevia-ions, or contractions contained in FAA Con-ractions Handbook 7340.1 (Series), and control nformation symbols contained in FAA Hand-ook 7110.65 (Series) must be used so that any vritten message may be read and understood by nother controller. Additionally, only the station nd NAVAID location identifiers contained in the FAA Location Identifiers Handbook 7350.4 (Series) should be used.

The following list includes approved prefixes used in conjunction with the serial number to identify the branch of service to which the aircraft is attached. These prefixes are appropriate for use in box number 1 on the flight progress strips.

Prefix	Branch
A	U.S. Air Force
C	U.S. Coast Guard
G	Army or Air National Guard
VM	U.S. Marine Corps
R	U.S. Army
VV	U.S. Navy
CAF	Canadian Armed Force
CAM	Canadian Armed Force (Transport Command)

The following list includes approved military mission prefixes which may be used with or in place of the prefix indicating branch of service. These prefixes may be used in conjunction with the aircraft serial number. The mission prefixes appropriate for use in box number 1 are:

Prefix	Branch
E	Medical Air Evacuation
L	LOGAIR (USAF Contract)
S	Special Air Mission
M	MAC (Military Airlift Command)

The following list contains approved aircraft equipment suffixes which are used to indicate that an aircraft has transponder with or without mode C (altitude encoding capability), DME, RNAV, or TACAN-only navigational capability. These suffixes are used following a slant mark (/) after

the aircraft type. They are appropriate for use in box number 3.

Suffix Meaning

/X . . . . . No transponder.

/T . . . . . Transponder with no altitude encoding capability.

/U . . . . . Transponder with altitude encoding capability.

/D . . . . . DME, no transponder.

/B . . . . . DME, transponder with no altitude encoding capability.

/A . . . . . DME, transponder with altitude encoding capability.

/M . . . . . TACAN-only, no transponder.

/N . . . . . TACAN-only, transponder with no altitude capability.

/P . . . . . TACAN-only, transponder with altitude encoding capability.

/C . . . . . RNAV, transponder with no altitude encoding capability.

/R . . . . . RNAV, transponder with altitude encoding capability.

/W . . . . RNAV, and no transponder.

NOTE.—RNAV refers to airborne area navigation systems certified for flying RNAV routes in accordance with FAA Advisory Circulars.

Figure 7-7 shows control information symbols used for recording clearances, instructions, and information on flight progress strips. Some of the symbols can be used in various boxes on both the departure and arrival flight progress strip; however, the most consistent use of these symbols may be in box number 9 on the flight progress strip where the ATC clearance to be issued to a departing IFR aircraft is recorded.

The following list includes approved clearance abbreviations used to record a particular clearance issued or to be relayed to an aircraft, or the status of a clearance. These abbreviations may be used in various boxes on flight progress strips.

Abbreviation Meaning

A . . . . . . Cleared to airport (point of intended landing)

B . . . . . . Center clearance delivered

C . . . . . . ATC clears (when clearance relayed through non-ATC facility)

CAF . . . Cleared as filed

D . . . . . . Cleared to depart from the fix

F . . . . . . Cleared to the fix

H . . . . . . Cleared to hold and instructions issued

L . . . . . . Cleared to land

N . . . . . . Clearance not delivered

O . . . . . . Cleared to the outer marker

PD . . . . . Cleared to climb/descend at pilot's discretion

Q . . . . . . Cleared to fly specified sectors of a NAVAID defined in terms of courses, bearings, radials, or quadrants within a designated radius.

T . . . . . . Cleared through (for landing and takeoff through intermediate point)

V . . . . . . Cleared over the fix

X . . . . . . Cleared to cross (airway, route, radial) at (point)

Z . . . . . . Tower jurisdiction

Symbol	*Meaning*
T→( )	Depart (direction, if specified)
↑	Climb and maintain
↓	Descend and maintain
→	Cruise
@	At
X	Cross
M→	Maintain
⇁7	Join or intercept airway/jet route/ track or course
=	While in controlled airspace
Δ	While in control area
↘Δ	Enter control area
Δ↗	Out of control area
NW↘⊖ ⊖↗NE ⊖→E	Cleared to enter, depart, or cleared through control zone. Indicate direction of flight by arrow and appropriate compass letter. Maintain Special VFR/IFR conditions (altitude, if appropriate), while in control zone.
250K	Aircraft requested to adjust speed to 250 knots.
-20K	Aircraft requested to reduce speed 20 knots.
+30K	Aircraft requested to increase speed 30 knots.
Ⓦ	Local Special VFR operations in the vicinity of (name) airport are authorized until (time). Maintain special VFR conditions (altitude, if appropriate).
>	Before
<	After or Past
ALT (red)	Inappropriate altitude/flight level for direction of flight. (Underline assigned altitude/flight level in red.)
/	Until
( )	Alternate instructions
~~Restriction~~	Restriction
⊤↓	At or Below

Symbol	*Meaning*
⊥↑	At or Above
—(Dash)	From—to (route or altitude)
V<	Clearance void if aircraft not off ground by (time)
C̶L	Pilot cancelled flight plan
✓	*EN ROUTE.* Aircraft has reported at assigned altitude. *Example:* 80✓
✓	*TERMINAL:* Information forwarded (indicated information forwarded as required)
O (red)	*EN ROUTE:* Information forwarded (Circle, in red, the time (minutes) and altitude when a flight plan or estimate is forwarded. Also circle, in red, revised information forwarded. Use this method in both inter-center and intra-center coordination)
(50)	Other than assigned altitude reported (circle reported altitude)
|10| / |6|	DME holding (use with mileages) (Upper figure indicates distance from station to DME fix, lower figure indicates length of holding pattern. In this example, the DME fix is 10 miles out with a 6 mile pattern indicated.)
⌒ (Mi.) (dir.)	DME arc of VORTAC or TACAN
C (Freq.)	Contact (facility) on (freq.), (time, fix, or altitude, if appropriate). Insert frequency only when it is other than standard.
R	Radar contact
R	*EN ROUTE:* Requested altitude (preceding altitude information)
R̸	Radar service terminated
Ⓧ	Radar contact lost
Ⓡ	Radar handoff (circle symbol when handoff completed)
RV	Radar vector
RX	Pilot resumed own navigation
E (red)	EMERGENCY
W (red)	WARNING
P	Point out initiated. Indicate the appropriate facility, sector, or position. *Example:* PZFW.

NOTE.—The absence of an airway or route number between two fixes in the route of flight indicates "direct"; no symbol or abbreviation is required.

Figure 7-7.—Control information symbols.

The following listed miscellaneous abbreviations are used mostly by approach control; however, there are occasions when control tower operations make use of them.

Abbreviation Meaning

BC.....Back course approach

CT.....Contact approach

I.......Initial approach

FA.....Final approach

MA....Missed approach

NDB...Nondirectional radio beacon approach

SI......Straight-in approach

TA.....TACAN approach

TL.....Turn left

TR.....Turn right

VA....Visual approach

Abbreviation Meaning

VR.....VOR approach

ILS....ILS approach

OTP...VFR conditions-on-top

PT... .Procedure turn

RX....Report crossing

RP.....Report immediately upon passing (fix/altitude)

SA.....Surveillance approach

PA.....Precision approach

Figure 7-8 shows the standard recording procedure for hand-printed characters on flight progress strips.

The following list illustrates some examples of how these abbreviations and symbols are used.

Example	Meaning
50/(Fix)	MAINTAIN 5000' UNTIL REACHING (Fix).
VFR/5'E	MAINTAIN VFR UNTIL 5 MINUTES EAST.

Typed	Hand Printed	Typed	Hand Printed	Typed	Hand Printed	Typed	Hand Printed
A	A	J	J	S	S	1	1
B	B	K	K	T	T	2	2
C	C	L	L	U	U	3	3
D	D	M	M	V	V	4	4
E	E	N	N	W	W	5	5
F	F	O	O	X	X	6	6
G	G	P	P	Y	Y	7	7
H	H	Q	Q	Z	Z	8	8
I	I	R	R			9	9
						*0	Ø

* The slant line cross through the numeral zero and the underline of the letter "S" on handwritten portion of the flight progress strips are required only when there is reason to believe the lack of these markings could lead to a misunderstanding. The slant line cross through the numeral zero is required on weather data.

Figure 7-8.—Recording of hand-painted characters.

Example	Meaning
VFR/10ME	MAINTAIN VFR UNTIL 10 NAUTICAL MILES EAST.
50/1020	MAINTAIN 5000′ UNTIL 1020.
OTP/270	Actual altitude on top—FL 270.
80↓50 1020	MAINTAIN 8000′; DESCEND TO 5000′ AT 1020.
70↓30 or 70↓30 1020 (fix)	MAINTAIN 7000′; DESCEND TO REACH 3000′ BEFORE 1020; or (Fix).
50↑90 VFR (50)	*CLIMB VFR FROM 5000′ to 9000′;* IF NOT POSSIBLE MAINTAIN 5000′.

NOTE: Altitudes are written in hundreds of feet; i.e., 5000 becomes 50, 1500 becomes 15, etc.

ATC Clearances

With a proposed IFR flight plan on file, the AC on duty at the ground control position in the control tower, clearance delivery, or departure control position, as appropriate, requests an ATC clearance from the ARTCC when the pilot calls the tower for taxi instructions or requests IFR clearance. ATC clearances, advisories, or requests must be relayed verbatim.

The following is an example of an ATC clearance received via Service F from the ARTCC of the proposed IFR flight plan shown in figure 7-2.

"NAVY FOUR MIKE ONE FIVE SEVEN, CLEARED TO THE NAVY PENSACOLA AIRPORT AS FILED, MAINTAIN ONE ZERO THOUSAND, SQUAWK ONE ONE ZERO ZERO, AFTER DEPARTURE CONTACT MEMPHIS CENTER. HOTEL ROMEO."

Figure 7-5 is a completed flight progress departure strip on which the clearance is recorded using appropriate symbols and contractions.

VFR FLIGHT HANDLING

When a pilot delivers a DD Form 175 to base operations and subsequently departs, the AC on duty must transmit the necessary information to flight service to be entered on the Area B teletype circuit for transmission to destination. All flights are held in suspense, or kept track of (until the aircraft lands), for the purpose of search and rescue service. The following brief discussion of what transpires from departure to arrival, gives you an idea of the entire operation.

NOTE: All messages concerning flight movements must be transmitted to flight service within 5 minutes after the required information is received.

Flight Notification Message

After an aircraft has departed or before actual departure for flights of short duration with mutual agreement, the following information from the flight plan must be transmitted to flight service:

1. Type of flight.
2. Aircraft identification.
3. Type of aircraft/special equipment suffix. (Include number and type of aircraft if a formation flight.)
4. Point of departure.
5. Point of destination.
6. Estimated time of arrival (ETA) at destination.
7. Remarks (VIP and passenger/cargo information).

The FSS then relays a flight notification message to the tie-in FSS serving the destination airport and holds the flight in suspense until the destination FSS acknowledges the message. If an acknowledgement for a flight notification message is not received from the destination FSS within the following time limits, FSS personnel may use regular telephone to assure delivery:

1. Before estimated time of arrival (ETA), if estimated time en route (ETE) is 30 minutes or less.
2. 30 minutes after departure if the ETE is between 30 minutes and 2 hours.
3. 1 hour before ETA, if the ETE is 2 hours or more.
4. 30 minutes after departure if the message contains VIP/RON (remain overnight) information.

When destination tie-in FSS acknowledges the flight notification message, the departure FSS then files it in a completed file. The destination FSS relays the message to the destination airport and holds the flight in suspense until an arrival report is received from the destination airport.

Stopover Flights

Flights which include stopovers en route to final destination are handled basically the same as VFR flights with the following exceptions:

1. The point of the first stopover and an ETA (in lieu of ETA at destination) at that point, followed by each stopover point and ETE in original flight notification message.
2. Each intermediate tie-in FSS will:

   a. Acknowledge receipt of departure message.

   b. Notify Base Ops of the inbound.

   c. Suspend the message until an arrival or closeout is received or take the necessary action if overdue.

   d. When received, forward a departure time to the tie-in FSS for the next stopover point and obtain an acknowledgement.

The destination tie-in FSS will take the same action as the intermediate FSSs except that the flight plan is closed out when an arrival report is received from destination Base Ops, or if no further information, such as departure time, is received from the preceding stopover point by the message VOID time.

En Route Changes

Flight service stations, when advised of a change in ETA or flight plan (VFR to IFR) by an en route aircraft, forward this information, or any other data requested by the pilot, to the destination station.

The FSS transmits a revised flight notification message, when a change in destination is received, to the departure point and to the original and new destination. The message includes the type of flight plan, aircraft type and identification, departure point, original destination, and the time and position when the aircraft requested the change. Included are the contractions "CHG DESTN", new destination, ETA, and any pertinent remarks.

Arrival Reports

Arrival reports are not transmitted to the departure FSS unless an aircraft arrives for which a flight notification message was not received. In such cases, ACs at the destination airport must provide the tie-in FSS with the aircraft identification, point of departure, and time of arrival to be relayed to the departure tie-in FSS and finally to the departure airport. Arrival reports are also required for overseas flights and special military flights of Presidential or Vice Presidential aircraft. An exception is that in Alaska, an arrival report is required on a military aircraft when departure is from a military base.

IFR FLIGHT HANDLING

Federal Aviation Regulations require, in part, that a flight plan be filed and an ATC clearance be obtained prior to operation within controlled airspace in accordance with instrument flight rules.

When a pilot files an IFR flight plan with base operations, the ACs on duty must transmit the proposed IFR flight plan message to the ARTCC in whose area the IFR flight originates.

The message may be sent to the ARTCC via Utility B teletype (Area B may be used through flight service in some cases) if the aircraft's proposed departure time is 15 minutes or more from transmittal time. If time is critical, the message is transmitted via interphone (Service F). Any subsequent change or cancellation to the proposed flight plan message must be called to the ARTCC via interphone.

IFR Flight Plan Message

The IFR flight plan message consists of the following items, all of which are from the filed DD-175 with the exception of items 1 through 4:

1. The 3-letter identifier of the ARTCC.
2. The 3-letter identifier of the originating station and four figures to indicate the time the flight plan was received by the station.

3. Three figures to indicate the number of the message. This number sequence begins with 001 each day at 0000Z.

4. The alphabetical characters FP. (All proposed IFR flight plan messages must contain these characters.)

NOTE: Items 1 through 4 are required on teletype only.

5. Aircraft identification.
6. Type aircraft/special equipment suffix.
7. True airspeed.
8. Departure point.
9. Proposed departure time.
10. Altitude
11. Departure point and route of flight. The route of flight must include the departure point, since it may be different from the station transmitting the message; the route of flight to the next fix; the identifier of that fix and route of flight to the next fix; and so on until destination which is the last part of this item.
12. Remarks: Preceded by the remarks code.

ARTCCs acknowledge all movement messages on Utility B and Area B circuits except domestic proposed IFR flight plan messages.

NOTE: An example of a proposed IFR flight plan message for relay by teletype is depicted in the section pertaining to teletype procedures.

Flight Service for IFR Flights

All procedures and reports as discussed earlier in this chapter for handling VFR flights apply to IFR flights as well. The exchange of information between base operations and the ARTCC is additional flight plan handling procedure required for the purpose of providing separation between aircraft operating IFR. In many instances certain reports must be sent to both Flight Service and the ARTCC.

If you compare the information in the route of flight section of the DD Form 175 depicted in figure 7-2 with the example of a proposed IFR flight plan message listed earlier in this chapter under RELAY OF FLIGHT DATA, Teletype Procedure, you can see that all of the information contained on the proposed flight plan is not included in the initial IFR flight plan message sent to the ARTCC for this flight.

The significance is that the flight plan is an IFR stopover proposal. Only the first leg of the flight plan is sent to the ARTCC as shown in the teletype message example since that is the extent of the ATC clearance that will be issued the pilot initially. However, the entire flight plan is transmitted to the departure tie-in FSS via interphone upon departure. Departure FSS then enters a flight notification message addressed to destination tie-in FSSs on Area B teletype. Then, when the pilot arrives at the first destination and notifies this FSS of his proposed departure time, the new departure FSS submits the next applicable leg of the stopover flight plan to the appropriate ARTCC as a proposed IFR flight plan message so the pilot can obtain ATC clearance to his next destination. This procedure is repeated until the pilot completes the flight.

IFR Departure Reports

Immediately after an IFR flight is airborne, a departure report must be sent via interphone (Service F) to the control facility with which the flight plan was filed. The departure report must contain the aircraft identification and the actual time of departure.

IFR Flight Progress Reports

IFR flight progress reports consisting of the aircraft identification, position, time, altitude or flight level, estimate of the next reporting point, name of the subsequent reporting point, and any remarks or requests as received from a pilot must be relayed to the appropriate ATC facility via interphone (Service F).

IFR Arrival Reports

The actual time that an IFR flight lands, executes a missed approach, or cancels the IFR flight plan must be relayed to the appropriate ATC facility via the most expeditious means available.

In addition to the above, ATC must be informed when one of its control messages has not been delivered:

1. Within three minutes of receipt; or
2. Within three minutes after the specified delivery time; or
3. By a specified cancellation time.

Combination IFR/VFR Flights

Pilots may file flight plans containing both VFR and IFR operations. Such flight plans are handled in the same manner as regular VFR or IFR flight plans except that the proposed IFR flight plan message is sent to the ARTCC in whose area of responsibility the aircraft changes from VFR to IFR.

If the first portions of such flights are IFR, or the change from VFR to IFR occurs at a position within the ARTCC's area within which the departure airport is located, the proposed flight plan message may be sent via teletype or Service F by base operations at the departure airport. If the first portion is VFR and subsequent portions are IFR in a different ARTCC's area, the proposed flight plan message would probably be sent via interphone to Flight Service for transmission on Area B teletype to the ARTCC in whose area the change from VFR to IFR occurs.

FLIGHT ADVISORY MESSAGES

If hazardous conditions arise which might affect an aircraft already in flight, it may be necessary to issue a flight advisory message to make sure the pilot is aware of the situation.

If a military aircraft's destination is a civil airport, the destination FSS is responsible for screening weather, airport, and NAVAID conditions, and issuing the necessary advisory to inbound aircraft. If the destination is a military base, the responsibility rests with base operations.

The tie-in station originating the advisory or receiving it from the originating base operation determines the FSS nearest the aircraft's position for VFR flights or the appropriate ARTCC for IFR flight, and transmits the message to that location.

If the receiving FSS or ARTCC is unable to deliver the flight advisory to the aircraft within 15 minutes after the requested delivery time, the originator must be informed and then the message is filed.

EXERCISE

7-5. Who has the responsibility for assuring that the appropriate flight service agency is furnished with the essential elements of the flight plan?

7-6. What form is used for all military flight plans within the United States?

7-7. What form is used for receiving a weather briefing?

7-8. For what period of time must flight planning and a completed weight and balance form be kept on file?

7-9. Referring to the VIP and passenger/ cargo codes, what do the following remarks indicate?

a. VIP V5H.

b. S DC 80 C50 T16 Q3M/11M-2F R.

c. In the remarks contained in b. above, how many passengers can the pilot take on flight's next leg?

7-10. What facility within the NAS has the prime responsibility for accepting and closing flight plans?

7-11. What interphone circuit connects Military Base Ops with ARTCC?

7-12. What teletype circuit related to Service B connects most Base Operations with ARTCCs?

7-13. Refer to the blank flight progress strips in figure 7-5 and 7-6. Complete this exercise by selecting the letter of the column B item which appropriately completes each statement in column A. Each item in column B may be used once or more than once.

COLUMN A

FAA Form 7230-8 Used for:

Departures Enter In:	Arrivals Enter In:
Item Position 1______.	Item Position 1______.
Item Position 3______.	Item Position 3______.
Item Position 5______.	Item Position 5______.
Item Position 6______.	Item Position 6______.
Item Position 7______.	Item Position 7______.
Item Position 8______.	Item Position 8______.

COLUMN B

a. Departure airport.

b. Coordination fix.

c. Requested altitude.

d. Beacon code assignment.

e. Proposed departure time.

f. Aircraft identification.

g. Type, number, and special equipment suffix.

h. Previous fix or inbound airway.

i. Estimated time of arrival at coordination fix or airport.

7-14. Column A contains a list of prefixes used in conjunction with an aircraft's serial number to identify the branch of military service or military mission. Match those prefixes in column A with the items listed in column B. The items in column B may be used only once or not at all.

COLUMN A	COLUMN B
1. A	a. U. S. Coast Guard
2. E	b. Army Guard
3. G	c. U.S. Army
4. VM	d. U.S. Air Force
	e. U.S. Marine Corps
	f. Medical Air Evacuation

7-15. Of the aircraft equipment suffixes listed earlier, which suffix(es) indicate an aircraft with (a) the LEAST equipment and (b) altitude encoding capability?

7-16. Using the previously listed abbreviations and figures 7-7 and 7-8, write the following meanings or clearances.

a. An aircraft is cleared to the airport of intended landing and the pilot is cleared to descend at pilot's discretion.

b. Clearance is void if not off the ground by 1430.

c. Maintain 5000′ until 1430, then climb to 9000′.

7-17. If the destination FSS fails to acknowledge a flight notification message from the departure FSS relative to a flight whose ETE is 2 1/2 hours, when must the departure FSS use a regular telephone to assure delivery of the message to the destination FSS?

7-18. In the above situation, when would the departure FSS use a regular telephone to confirm delivery of the message if the flight notification message contained the following remarks? S V5N R NIP

7-19. Match the types of messages or statements listed in column A with the specified time listed in column B. The times listed in column B may be used more than once or not at all.

COLUMN A	COLUMN B
1. Service F may be used to relay an IFR flight plan to ARTCC if proposed departure time is within ______minutes.	a. 3 minutes b. 5 minutes c. 15 minutes
2. IFR departure time.	d. 30 minutes
3. Originator must be informed when a flight advisory message cannot be delivered within ______ minutes of the requested delivery time.	e. Immediately
4. Control messages.	

SEARCH AND RESCUE (SAR) PROCEDURES

Learning Objective: **Identify the conditions which require SAR operations and state the procedures followed in effecting SAR for both IFR and VFR flights.**

Search and Rescue is a lifesaving service which provides search, survival aid, and rescue of personnel of missing or crashed aircraft. This vital responsibility is assigned to the U.S. Air Force and the U.S. Coast Guard as outlined in the National Search and Rescue Plan.

These two agencies are further assisted by the combined efforts of the Navy, FAA, Civil Air Patrol, State Police, and other organizations that may be called upon to render assistance.

The following section is a list of terms or definitions with which you must be familiar, to better understand SAR procedure:

1. Inland SAR Region.—The area in which the USAF exercises the SAR coordinating function. It includes all of the inland area within the conterminous U.S. except the waters under jurisdiction of the U.S. Coast Guard for SAR purposes.
2. Maritime Region.—The area in which the U.S. Coast Guard exercises the SAR coordinating function, including the territories and possessions of the U.S. and high seas.
3. Rescue Coordination Center (RCC).—A center which coordinates and controls SAR operations in a region, subregion, or sector.
4. Alert Notice (ALNOT).—Notice given to appropriate facilities and agencies that an aircraft is overdue.
5. Information Request (INREQ).—A request for information concerning an overdue VFR aircraft.

NOTE: For complete details of procedures used in Search and Rescue, refer to the National Search and Rescue Manual.

SAR PROCEDURES FOR VFR FLIGHTS

Responsibility

The departure station (tie-in station) is responsible for initiating SAR action on flights for which flight plans have been entered into the FAA communications system until receipt of the destination station's acknowledgment of the flight notification message. Then the responsibility is transferred to the destination (tie-in) station. Military base operations offices are responsible for initiating action on all other flights.

A VFR or DVFR flight is considered overdue when communication cannot be established with it and it fails to arrive 30 minutes after its ETA.

A flight not on a flight plan is considered overdue if a reliable source reports it one hour overdue at destination.

Overdue Aircraft Action

As soon as a VFR aircraft becomes overdue, the destination tie-in station (including intermediate destination tie-in stations for military aircraft) shall attempt to locate the aircraft by checking all adjacent airports that can be reached by government circuits or local telephone. If necessary, a long distance telephone call may be made to the destination airport.

If this communications search (FAA's responsibility for SAR is limited to communications and alert) does not locate the aircraft, the signal QALQ is transmitted to the departure tie-in station.

NOTE: Q signals are listed in FAA Flight Service Handbook 7110.10. The Q signal above is a code for asking if the aircraft in question has landed at or returned to the station queried.

Upon receipt of such an inquiry, the departure tie-in station must check locally for any information about the aircraft. The results of the check must then be transmitted back to the destination station.

Information Request (INREQ)

If the reply to the QALQ is negative or if the aircraft has not been located within 30 minutes after it becomes overdue, the destination station must transmit a numbered INREQ message to stations along the route, to the departure station, and to the destination RCC tie-in station (an FSS with interphone to the appropriate RCC). For example, an INREQ is issued:

1. For aircraft on a VFR flight plan—30 minutes after it becomes overdue (1 hour after ETA).
2. For aircraft not on a flight plan—30 minutes after it becomes overdue (1 1/2 hours after ETA).

NOTE: For special procedures peculiar to Alaska and Hawaii, refer to FAA Flight Services Handbook 7110.10.

En route stations receiving an INREQ must seek information about the aircraft by checking station records and inquiring at all local airports which can be contacted by interphone or telephone. A reply to the INREQ must be sent to the originating station within one hour after receipt even if the report is negative. If a search cannot be completed within one hour, a status report is sent to the originating station followed by a completion report when available.

The departure station has already conducted a local communications check and holds the INREQ message in suspense.

If the aircraft is located by the INREQ, the originator must transmit a numbered message to all original INREQ addressees informing them of the fact.

Alert Notice (ALNOT)

If replies to the INREQ have been negative or the aircraft has not been located within one hour after the transmission of the INREQ, whichever occurs first, the destination station must transmit an ALNOT to the RCC tie-in station and all Area B circuits serving the ALNOT search area.

The ALNOT search area is normally that area extended 50 miles on either side of the proposed route of flight from the last reported position to the destination station. However, if requested by the RCC, or at the discretion of the destination station, the ALNOT search area may be expanded to the maximum range of the aircraft.

Upon receipt of an ALNOT, each station whose area of responsibility extends into the ALNOT search area must conduct a communications search of those airports which could accommodate the aircraft and which were not checked during the INREQ search.

Receiving stations must notify the originator within one hour after receipt of the results or the status of the search.

If the ALNOT search fails to locate the aircraft or one hour has elapsed since transmission, whichever occurs first, the destination station must notify the RCC by message via the RCC tie-in FSS.

All available information about an overdue aircraft must be given the RCC, including:

1. Agency and the person calling.
2. Details of the flight plan, or if the aircraft was not on a flight plan, all the facts about the source of the report.

3. Time of last radio contact, with whom the contact was made, and the frequency used.
4. Last position report.
5. Action taken and proposed action by the reporting station.
6. Positions of other aircraft known to be along or near the route of flight of the missing aircraft upon request.
7. Whether or not an emergency locator transmitter (ELT) was received, by whom, and the frequency used.

The ALNOT remains current until the aircraft is located or the search is suspended by the RCC. The ALNOT originator must then notify all agencies which were previously alerted and cancel the ALNOT by message on all circuits over which it was originally transmitted.

Hazardous Areas

When regularly traveled VFR routes cross large bodies of water, swamps, mountains, or other hazardous areas where survival depends upon rapid rescue, a plan may be established by local authorities for special rescue procedures.

Because of the variety of possible situations, a standard procedure is not prescribed. Generally, these plans depend on a contact every 10 minutes with aircraft crossing these areas. If contact is lost with the aircraft for more than 15 minutes, SAR is alerted.

NOTE: Refer to AIM Part I for the chart depicting these areas.

SAR PROCEDURES FOR IFR FLIGHTS

ARTCCs are responsible for assuring that SAR procedures are initiated for overdue IFR aircraft. ARTCCs serve as the central point for collecting information, coordinating with the RCC, and conducting a communications search for overdue or missing IFR flights.

For SAR purposes, ARTCCs consider combination VFR/IFR flights and air-filed IFR flights the same as IFR flights when 30 minutes have elapsed since the pilot requested clearance and radio communication or radar contact cannot be established.

An IFR aircraft is considered overdue when neither radio communication nor radar contact can be established with it and 30 minutes have elapsed since an ETA over a specified or compulsory reporting point or clearance limit.

Overdue Action

The ARTCC in whose area of responsibility an IFR aircraft is first unreported or overdue is responsible for making this determination and initiating the necessary action. When an IFR aircraft is determined overdue, the appropriate ARTCC must alert the associated RCC and transmit an ALNOT.

The ALNOT is sent to all ARTCCs and Area B circuits 50 nautical miles on either side of the route of flight from the last reported position to destination. Included in the ALNOT is the original or amended flight plan, as appropriate, and the last known position. At the recommendation of the RCC or at the discretion of issuing ARTCC, the ALNOT search area may be expanded to cover the maximum range of the aircraft.

The responsibility for further search is transferred to the RCC under any of the following conditions:

1. When 30 minutes have elapsed after the estimated fuel exhaustion time.
2. When the aircraft has not been found within 1 hour after issuing the ALNOT.
3. When the ALNOT search has been completed with negative results.

The ALNOT remains in effect until the aircraft is found or the search is abandoned by the RCC, at which time it must be cancelled by the originating ARTCC.

Handling procedure for stations receiving the ALNOT, are the same as those listed under SAR procedure for VFR flights.

EXERCISE

7-20. What two agencies are assigned the overall responsibility for Search and Rescue within the U.S. including its territories and possessions and the high seas?

7-21. Of the three SAR messages relating to an overdue VFR flight plan aircraft (ALNOT, INREQ, and QALQ) which is transmitted first?

7-22. Of the above messages, which initially alerts RCC of an overdue (a) VFR aircraft, (b) IFR aircraft?

7-23. You have an aircraft on a VFR flight plan estimating your station at 1200. In your own words, outline the actions you should take and when you would take them if this aircraft became overdue. Explain the situation from the ETA through to the cancellation of the ALNOT.

7-24. When does ARTCC issue an ALNOT on an overdue IFR aircraft?

7-25. When is the responsibility for further search for an overdue aircraft transferred to RCC?

NOTICE TO AIRMEN (NOTAM)

Learning Objective: **Recognize individual and activity responsibilities for originating and executing procedures under the notices to airmen (NOTAM) system, the meanings and format of a NOTAM accountability number, services provided by the parts of the NOTAM summary, and frequency of NOTAM display board posting.**

The purpose of the NOTAM system is to assist the pilot in conducting safe and efficient flight operations. The NOTAM system provides accurate and timely information about terminal facilities at the Air Force, Navy, and Marine bases and at selected Army and civil facilities. You, as an AC, will be directly concerned with the preparation, receipt, and posting of NOTAMs.

A NOTAM is defined as, "Aeronautical information about the establishment, condition, or change in an aeronautical facility or service, or about a procedure that may be a hazard to flight". NOTAMs require fast and wide dissemination by telecommunications means.

Since you are primarily associated with U.S. Naval facilities, the function of the joint U.S. Air Force/U.S. Navy Notice to Airmen system is of the utmost importance to you.

USAF/USN NOTAM SYSTEM

The USAF/USN NOTAM system was established to provide for rapid dissemination of Navy, Air Force, and selected civil NOTAMs in plain language to USAF and USN air activities, and provide for frequent, periodic summaries of current NOTAMS.

This system is centrally coordinated and operated by the USAF Central NOTAM Facility (AFCNF). The USAF CONUS Meteorological Data System (COMEDS) is used for the transmission of these NOTAMs. Navy and Marine Corps air facilities in the conterminous U.S. have transmit and/or receive capabilities on the COMEDS system.

Central NOTAM facilities are also established at certain overseas locations for the purpose of exchanging Navy and Air Force NOTAMs within each area and between each area, and the U.S. NOTAMs in these systems are transmitted over existing administrative and operational circuits. In addition, there is an integrated worldwide system of aeronautical fixed circuits used to exchange messages between international civil and military NOTAM offices. This system is known as the Aeronautical Fixed Telecommunication Network (AFTN).

NOTAM RESPONSIBILITY

The U.S. Air Force has the responsibility for the overall management, operation, and maintenance of the NOTAM system. The U.S. Navy coordinates with the Air Force on the development of policies and procedures that govern the use of the NOTAM system. In

addition, the U.S. Navy provides guidance to U.S. Navy units that use the NOTAM system. This guidance is provided by the Naval Flight Information Group (NAVFIG), Naval Air Facility, Andrews AFB, Washington, D.C. NAVFIG manages Navy NOTAM functions and monitors Navy NOTAMs to ensure compliance with the appropriate instructions governing NOTAM procedure.

The responsibility for originating a NOTAM rests with the commanding officer having jurisdiction over a facility where a hazardous condition exists or is contemplated. This responsibility includes ensuring that NOTAM dissemination is adequate and timely and that NOTAMs are promptly canceled.

Additionally, the commanding officer (clearing authority) is responsible for the promulgation of all NOTAMs received. This responsibility includes, but is not limited to, conspicuous posting within flight planning areas and dissemination to local units within their area of jurisdiction. Timeliness of this information is often critical to the safety of flight operations. Therefore, all NOTAM information must be handled and processed within 15 minutes. Managers at all levels must make sure that procedures and personnel conform to this requirement.

Each activity concerned with the issuance of NOTAMs must implement standard procedures to assist appropriate duty personnel in the correct preparation, transmission, and display of NOTAMs.

Originators of NOTAMs must ensure the following:

1. There are adequate on-station procedures to provide rapid reporting of NAVAID malfunctions that affect the operation of the station, regardless of the operating agency of the facility concerned.
2. There are standardized station procedures for the preparation of each NOTAM in accordance with the requirements for the particular circuit on which it is to be transmitted. The NOTAM is normally prepared by ATC personnel.
3. Each item is carefully phrased and identified as a separate NOTAM, and the same accountability identifier is used in any revisions to or cancellation of the NOTAM.
4. Each station NOTAM is retransmitted by the AFCNF within a reasonable time frame (normally one hour) and ensure it was retransmitted as submitted to the AFCNF.
5. Follow-up of station-originated NOTAMs to provide for prompt and accurate publication, revision, and cancellation as soon as the condition is rectified or published in Flight Information Publications (FLIPs).
6. The NAVFIG forwarded any amplifying data necessary for permanent or semipermanent changes to the appropriate FLIPs.

NOTAM TERMS

The following explanations of terms should be helpful to you in your study of this section.

1. Airmen Advisory. A Notice to Airmen normally given only local dissemination or during preflight or inflight briefings.
2. Automatic Response to Query (ARQ). A method of rapid computer recall of specified information.
3. Base. As used in this publication, any installation owned, leased, operated, occupied, or jointly occupied by a Department of Defense (DOD) unit or organization where flying of DOD aircraft is conducted.
4. Base Accountability Number. A two-digit number a base assigns each new NOTAM for accountability in the NOTAM file. This number is assigned in numerical order from 01 through 99, beginning the first of each month. The same number is used in the message text for later revisions or cancellations to that NOTAM.
5. Base Operations. A facility operated under the authority of a base or facility commander to support flight operations.
6. CONUS Meteorological Data System (COMEDS). COMEDS is a network of multipoint circuits connected to the Carswell Automatic Digital Weather Switch (ADWS). Terminal equipment consists of Receive Only Printers and Keyboard Visual Display devices. COMEDS replaced the CONUS Meteorological Teletype (COMET, I, II, III) networks, as well as the NOTAM only circuits. COMEDS supports DOD

and selected civilian agencies for the collection and dissemination of military weather and NOTAM message traffic.

7. Hold NOTAM. A NOTAM that does not become effective until 18 to 96 hours from the time it is received by the AFCNF. The AFCNF accepts NOTAM information up to 96 hours before it becomes effective. NOTAMs with effective times less than 18 hours from the time of the next summary are published on hourly updates. NOTAMs with effective times 18 to 96 hours from the time of the next summary may be held for publication on the next summary, which includes the base or area concerned. Base operations must check that summary to ensure that the NOTAM is published correctly.

8. Hourly Update. A cumulative listing of changes to the current NOTAM summary.

9. International Civil Aviation Organization (ICAO) NOTAM Office. An international NOTAM office (military or civil) that transmits NOTAMs according to ICAO procedures, Annex 15.

10. National Airspace System (NAS). The common network of US airspace, navigational aid (NAVAIDs), communications facilities and equipment, air traffic control equipment and facilities, aeronautical charts and information, rules, regulations, procedures, technical information, Federal Aviation Administration (FAA) work force, and material. This includes parts of the system shared with the military. (See FAA Handbook 7110.10.)

11. NOTAM Code (commonly called the ICAO code). The code used to relay information on the status of radio aids, aerodomes, lighting facilities, and dangers to aircraft in flight. It is used only to transmit NOTAMs from ICAO NOTAM offices. When a NOTAM is received in "Q" Code, it is transmitted over Air Force communications circuits in clear text, using NOTAM and Flight Information Publications (FLIP) abbreviations. (See FLIP General Planning and FAA Handbook 7110.80 for abbreviations and ICAO Q codes.)

12. NOTAM Identification Code. An alphanumeric code, made up of a letter for the type of NOTAM (N-New, R-Revised, C-Cancellation), and a six-digit number (two digits for the day, two digits for the month, and the two-digit base accountability number).

13. Self-Cancelling NOTAM. A NOTAM that has a date-time group showing when the condition will cease.

14. Summary. A list of all active NOTAMs in a theater, compiled and transmitted at specified times during the day. (The North American Summary (NAMSUM) is normally transmitted Sunday through Friday at 1630Z.)

CONDITIONS REQUIRING A NOTAM

The subject matter of a USAF/USN NOTAM must be limited to a condition which would affect an aviator's decision to operate to or from an airfield, or which would affect the safe en route passage of his aircraft. Examples of these conditions are as follows:

1. Establishment, permanent withdrawal, breakdown, outage, or change to electronic air navigation aids or lighting equipment.
2. Complete or partial closing of an aerodrome by a condition which precludes or seriously limits aircraft operations. For example, restrictions such as prior permission required (PPR) or official business only.
3. Significant corrections or changes to current editions of FLIPs or flight charts.
4. Temporary conditions affecting an instrument approach procedure which constitute a hazard to flight. In such cases, a NOTAM shall be issued amending or suspending the affected approach procedure.
5. Change in entry regulations or other significant conditions in foreign areas which may affect U.S. military flight operations.
6. Certain aerial activities, including controlled firing and missile launch areas that are *immediately hazardous to flight.*
7. An activation or establishment of a prohibited, danger, warning, alert, restricted, or military operating area (MOA); or when activities occur outside FLIP-published times or altitudes.

NON-NOTAM INFORMATION

A NOTAM must not be sent for the following conditions.

1. Local airfield conditions that could be hazardous but would not prohibit safe operation.

This information should be sent to air traffic control agencies, for delivery to inbound and departing aircraft, as airmen advisories.

2. Messing facilities, transient billets, hotel reservations, box lunches, transportation, limited servicing, limited parking, etc.

3. Weather conditions or the working status of weather measuring devices.

HOW TO PREPARE A NOTAM

Each NOTAM is identified by its date and base accountability number; for example, N100206. This NOTAM identification is broken down thus: 10 (day of month), 02 (month of February), and 06 (sixth NOTAM issued by the reporting base that month).

Once this number is assigned, it must be used to refer to the NOTAM for all purposes, including revision (R) and cancellation (C). The AFCNF uses the base accountability number to verify that it has received all NOTAMs from the respective bases.

NOTAM Content

NOTAMs are transmitted in clear text using authorized abbreviations. The message tells what is essential about the deficient service, facility, or hazard, but does not explain the contributing factors. The text must be clear, concise, and complete. There are three categories of NOTAMs: (1) General Special Notices, (2) Special and En Route NOTAMs, and (3) Base and Facility NOTAMs; however, we only cover the Base and Facility NOTAMs here. The content of the other categories of NOTAMs are essentially the same.

NOTAMs must contain the following items:

1. The prefix—NOTAM
2. The four letter ICAO station location identifier.
3. A letter identifying the NOTAM as: new (N), revised (R), or cancelled (C).
4. NOTAM identification number.
5. Name of the base.
6. Type of facility.
7. Condition of facility.
8. Remarks, if necessary.

EXAMPLE: NOTAM
KNIP
N060101 JACKSONVILLE NAS
TACAN OUT

New NOTAM

If a facility or service can no longer serve arriving, departing, or en route aircraft, it is NOTAMed as being out. Explanatory remarks, such as "awaiting flight check," "on test status," "not monitored," and so forth are NOT used. The facility is out. When these conditions are reported the NOTAM is classified as new and the identification number is preceded by the letter N, as illustrated in the above example. A self-cancelling NOTAM is prepared in the same format as a new one. However, the date and time the NOTAM is to be cancelled is shown within the NOTAM.

A self-cancelling NOTAM is shown below:

EXAMPLES· NOTAM
KNIP
N060101 JACKSONVILLE NAS
TACAN OUT THRU 061400/062300
JAN

or

NOTAM
KNIP
N060101 JACKSONVILLE NAS
TACAN OUT THRU 062300
JAN

In both cases shown in the above example, the TACAN will again be operational (IN) at 2300Z on the 6th of January. Thus the NOTAMs are self-cancelling.

Revised NOTAM

A revised NOTAM is sent to update or correct an existing NOTAM. The identification code used in the original format is the same; however, the letter R is used instead of N. If we wanted to revise the IN time for the above NOTAM to 070200, it would appear as such:

NOTAM
KNIP
R060101 JACKSONVILLE NAS
TACAN OUT THRU 070200 JAN

Cancelled NOTAM

When cancelling a NOTAM, again the original identification code is used, but, it is prefixed with a C instead of N. The cancellation NOTAM must tell the present condition of the facility.

EXAMPLE: NOTAM
KNIP
C060101 JACKSONVILLE NAS
TACAN IN

NOTE: The following rules apply to the use of dates and times in NOTAMs and are included in the remarks section of the NOTAM.

1. All dates and times expressed in NOTAMs are Greenwich Mean Time. The letter "Z" is not used following time or date time groups. "Zulu" time is implied.

2. If a NOTAM is to be effective at 2400 hours, the time 0001 should not be included. Use only the date. Example: 05 Dec.

3. The time 0500/1600 indicates 0500 through 1600. At 1601 the NOTAMed condition is cancelled.

4. The DATE "through 15 Nov" indicates the NOTAM is valid until 2400 hours on the date indicated.

5. "Through NOV" indicates the NOTAM is in effect until 2400 hours on 30 Nov.

POSTING NOTAMs

Each activity must maintain a standard NOTAM Display Board (figures 7-9 and 7-10) in

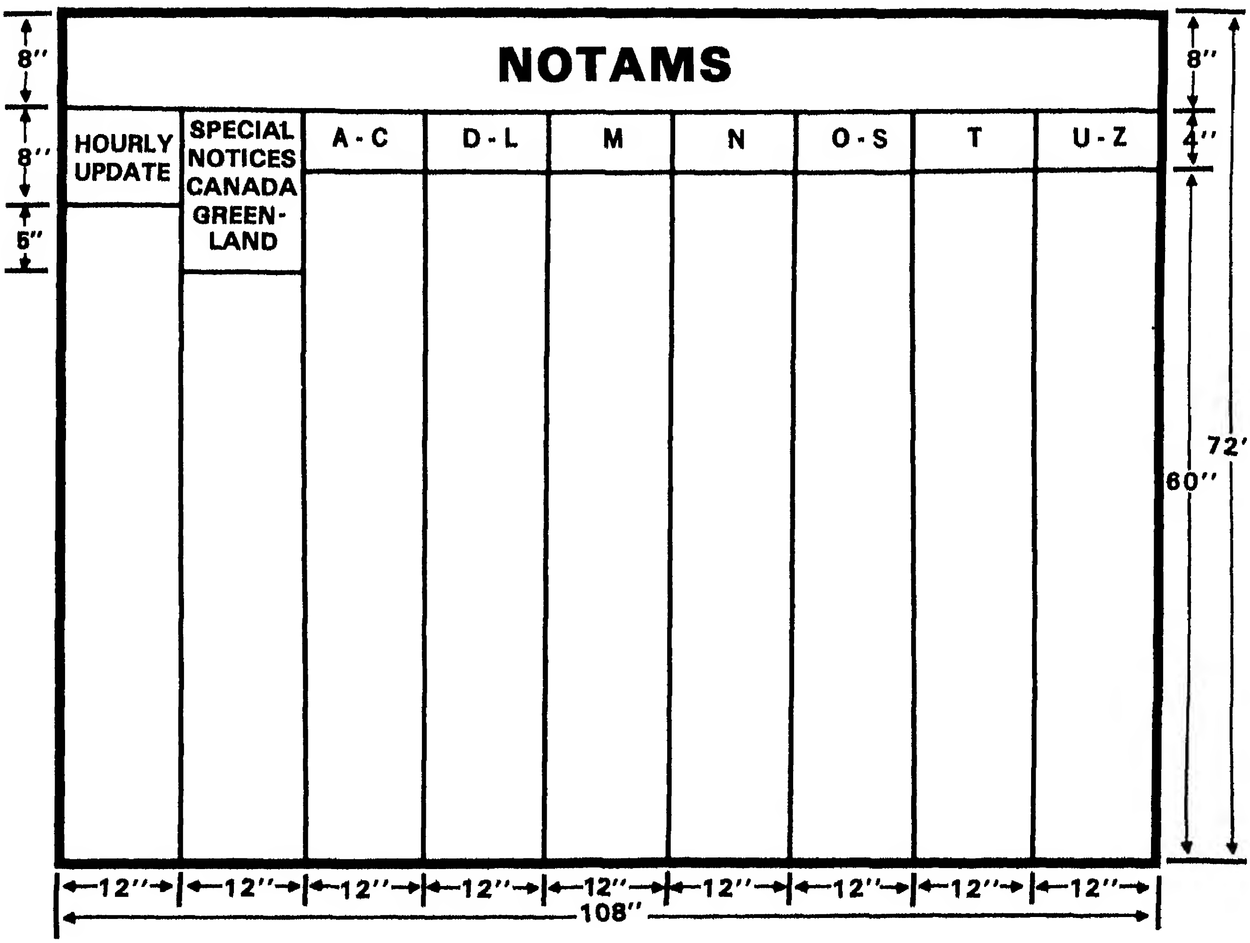


Figure 7-9.—NOTAM Display Board (CONUS).

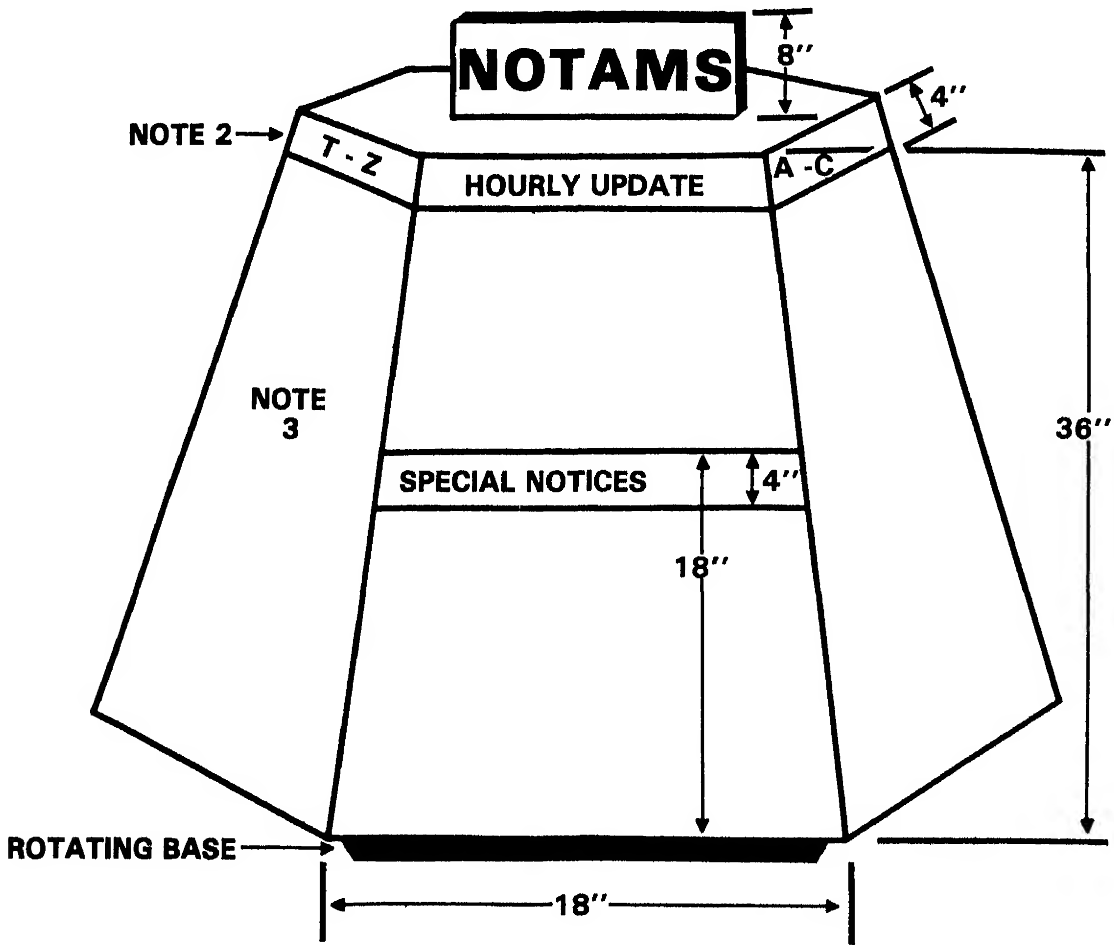


Figure 7-10.—Alternate NOTAM Display Board.

the flight planning area in accordance with the procedures outlined in OPNAV Instructions 3721.1 and 2112.2. Standard Display procedure must be implemented at each activity to assist ACs on duty in maintaining the NOTAM display including the following:

1. Adequate procedures for the receipt, on-station dissemination, and posting of incoming terminal, en route, and special NOTAMs from appropriate circuits.
2. Constantly updating the display and removing obsolete information at least once each hour, or more often.
3. Checking new Summaries for completeness before destroying old Summaries.
4. Monitoring NOTAMs and NOTAM Summaries, and new editions of FLIPs, to ensure that they reflect current conditions for their station, and initiate corrective NOTAMs on any deficiencies.
5. Decoding ICAO coded NOTAMs and identifiers to plain language before posting.
6. Availability of sufficiently knowledgeable personnel to assist the pilot in checking NOTAM information.

Records of NOTAM control must be kept by each installation having a NOTAM capability. Records must contain the source of information, activity reported, NOTAM accountability number, time submitted, confirmation of

transmission on COMEDS, and other information deemed pertinent. Sample forms which may be used for this purpose are contained in OPNAV Instruction 2112.2. For more detailed information concerning NOTAMs, you should refer to OPNAV Instruction 2112.2 and FAA Handbooks 7110.10 and 7110.80.

EXERCISE

7-26. The USAF/USN NOTAM system is centrally coordinated and operated by what agency/facility?

7-27. What office provides to Navy units and monitors Navy NOTAMs to ensure compliance with the appropriate instructions governing NOTAM procedures?

7-28. Who has the responsibility for originating a NOTAM at a Naval Air Station?

7-29. When are the North American Summary (NAMSUM) normally transmitted and how is it updated?

7-30. Prepare a sample NOTAM for the following conditions: (NOTE: 14 NOTAMs have already been sent during the month of November).

a. A NOTAM for Norfolk NAS (KNGU) showing that their TACAN went down at 1430Z, November 30.

b. At 0215Z, December 1, Norfolk's TACAN is back on the air; cancel the previous NOTAM.

c. Jacksonville NAS has issued three NOTAMs to date, June 20. Due to a local air show, Navy Jax (KNIP) will close its field to all nonparticipating aircraft between 1600 and 1930Z, June 22.

CHAPTER 8

AIRPORT LIGHTING, MARKINGS, AND EQUIPMENT

AIRPORT LAYOUT

Learning Objective: **Recognize the factors to be considered in the selection of an airport site and identify standard airport markings.**

As a Traffic Controller, you must have a thorough knowledge of the airport layout, airfield markings, and airfield lighting equipment to effectively control traffic on and in the vicinity of the airport.

SELECTION OF SITE

Why did the Wright brothers journey from Ohio to Kitty Hawk, North Carolina, to conduct their early tests? They were selecting a site, and for a very good reason. Their main concern in the selection of a site was the prevailing wind conditions. They knew from earlier experiments that their fragile and somewhat low-powered aircraft needed the advantage of a steady wind to become airborne. The site at Kitty Hawk offered such an advantage.

In the early days of aviation a smooth field at the edge of town served quite well as an airport. Then, as aircraft became heavier and faster, and with the advent of instrument flying, bigger and more elaborate facilities had to be constructed. The airport of today is much more complex than in the past, and many factors must be considered in selecting a site. Some of the major factors are adequate area, accessibility, weather conditions, and terrain.

Adequate Area

The site selected must offer a sufficient and suitable area for the required airport facilities. In the past years of aviation it was difficult to predict the rapid growth of aviation. High performance aircraft and the great volume of air traffic that grew so fast caused some airport areas to become inadequate. To add to the problem, cities and towns grew outward to meet the airport area. In planning a modern airport, careful consideration should be given to possible expansion in the future. Consideration must also be given to areas of congestion/population and appropriate Airfield Installation Compatibility Use Zones (AICUZ) and noise surveys conducted.

Accessibility

Another aim of site selection is to ensure that enough supply routes are available either by land, water, or by air. Railroads and surrounding highways simplify the supply problem. When an airport is planned to serve a metropolitan area, it is necessary to locate the airport where it is easily usable to the city and still does not create a hazard in the congested areas.

Many Navy airports exist for the primary purpose of supporting the fleet. To best serve this need they must be easily accessible. Their easy accessibility contributes not only economically, but to the combat readiness of fleet units.

Weather Conditions

Prevailing weather conditions should also be considered. By checking past National Weather Service records of the area, future weather

conditions can be predicted rather accurately. From an operational standpoint, some things to consider are the frequency, severity, and persistence of wind, fog, snow, and rainfall. Additional items to be considered are the need for snow removal equipment, number and type of instrument landing aids, and elaborate drainage construction in areas of heavy rainfall. These factors figure greatly in the cost of construction and maintenance of any airport.

Terrain

A site with favorable topography (surface features) is one located on high ground with sufficient slope for natural drainage and a reasonably level surface. Rough or hilly terrain can easily become hazardous to low-flying aircraft operating from an airport. In addition, rugged terrain can greatly increase the cost of construction.

The proposed area should be flight-tested for planning approaches to future runways. Special attention should be given to the possibility of shifting wind, downdrafts, and the presence of air eddies that may affect these approaches. From these tests it may even be decided that the proposed site is not a good one.

FACILITIES

Throughout the development and construction of airports, facilities have become more standard in the Navy. In keeping with this standardization, further studies of greater scope and magnitude are presently underway due to progress in the development of aircraft and related installations. The facilities aboard any military airport are many and varied. You must keep abreast of airport advances and the facilities that are available in order to properly handle and to expedite air traffic.

Runways

A runway is that portion of the landing area, usually paved, upon which aircraft actually land and take off. Runway pavement is designed to meet rigid specifications under certain conditions and to resist jet blasts and fuel spillage. The number and position of runways are decided from an analysis of wind and other pertinent data.

Many variables must be considered, such as the number of taxiways required, types of instrument approaches available, type of aircraft operations, etc. When more than one runway is considered for an airport, the main runway is determined by the direction of maximum wind coverage (prevailing wind) to facilitate landings and takeoffs into the wind. The secondary and subsequent runways are oriented to provide the greatest overall wind coverage. This plan is generally the most widely followed. However, adjustments may be required for surrounding developments, local terrain features, excessive construction problems, or alignment of an instrument runway to suit all weather conditions. At airports where the volume of traffic would be restricted by the availability of only one runway, parallel runways may be incorporated either in the original design or added later as necessary.

Factors which determine the length of the primary runway are the elevation of the field, mean maximum temperature, and the principal types of aircraft that will be operated from the field.

Runway length requirements are as follows:

Primary (Prop)	8,000 feet
Primary (Jet)	10,000 feet
Secondary runway	8,000 feet
Test facility	14,000 feet

Runway widths are normally 200 feet.

Some of the Navy's airports do not meet the preceding standards, but future construction and modernization of existing facilities will meet these requirements.

Runway Overrun Areas

Runway overrun areas are usually unpaved, relatively smooth areas which extend beyond the ends of runways. A portion of this area is constructed of selected materials, compacted and stabilized. This stabilized area is essentially an

extension of the runway. The primary purpose of runway overrun areas is to provide a reasonably effective deceleration area for aborting or overshooting aircraft. This area may also serve as an emergency all-weather access for fire-fighting, crash, and rescue equipment. Provisions are made at the upwind end of takeoff runways for a crash strip which is an extension beyond the overrun area. Takeoff runways are those runways whose takeoff usage exceeds 40 percent of total takeoffs. All obstructions are removed and ditches, gullies, and embankments are leveled off into the general profile of the extended centerline of the runway to minimize damage to aircraft.

Some runways have paved overruns, and the area is marked with yellow chevrons across the area. (Runway markings are discussed later.) With this type marking, it becomes a nontouchdown area. At some airports these areas are called blast pavements, used primarily to prevent erosion of runway ends from propeller and jet blast. They are usually made of highway paving material and do not have runway-bearing strength.

Taxiways

A taxiway is a specially prepared area, or lane, over which aircraft usually operate under their own power to and from the landing and parking areas. Taxiways should be constructed to the same specifications as the runways except for dimensions. A warmup area, usually an expanded portion of the taxiway adjacent to the end of the runway, is used for aircraft holding, engine warmups, and checking aircraft instruments and radio equipment. In any event, the warmup area must be of sufficient length to permit aircraft to hold at least 175 feet clear of the runway in use.

Parking Areas

These are hard-surfaced areas located in the vicinity of hangers for the purpose of parking, servicing, and loading aircraft. They are connected to the runways by taxiways, and normally padeyes are sunk into the surface for tying down aircraft during storm conditions.

Compass Calibration Pad

An aircraft compass calibration pad is a paved area in a magnetically quiet area where the aircraft compass is calibrated. (See figure 8-1.) There are two types of calibration pads:

1. Type I is used with the magnetic compass calibration set.
2. Type II includes a compass rose and turntable and may be used either with or without the compass calibration set.

Either pad handles one aircraft at a time. A minimum of one pad is provided at each airport; however, additional pads may be required based on local demand. The time required to calibrate one aircraft compass using the magnetic compass calibration set is about two hours. When a Type II compass calibration pad is used without the magnetic compass calibration set, the time required is about one hour.

The surface is marked every 15 degrees to indicate magnetic bearings beginning with

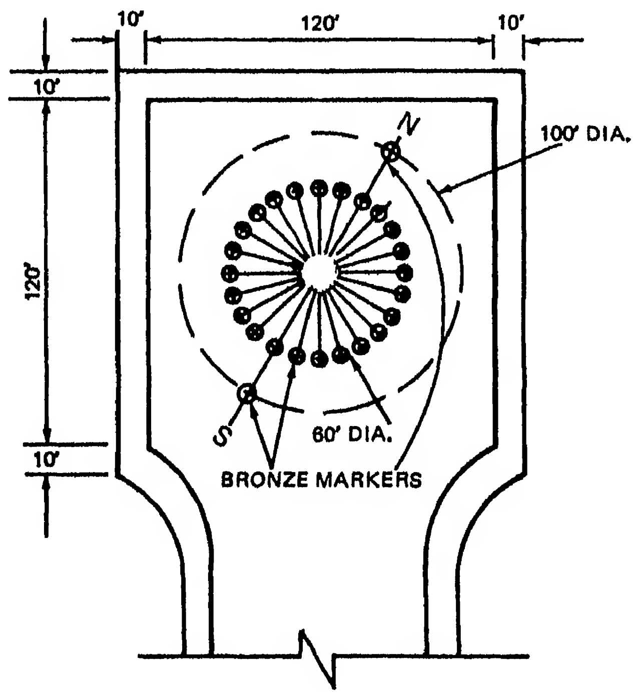


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Figure 8-1.—Typical compass calibration pad.

magnetic north. The taxiway to the compass rose is generally placed perpendicular to the taxiway with the least traffic. All metal used in the construction of a compass rose is either brass or bronze because it does not affect magnetic instruments. Other metal objects should be kept clear of the area when the compass rose is in use. In calibrating an aircraft compass, all electrical equipment is turned on and the engines kept running to simulate actual flight conditions.

AIRFIELD PAVEMENT MARKING

Runway Markings

Runway numbers which appear near the approach end of all runways indicate the magnetic heading of the runway. The number assigned to a runway is one-tenth of the magnetic compass reading to the nearest whole number. This means that when a pilot lands toward the South with a compass reading of 168 degrees, the landing runway should be 17. (If the last figure is 5 or more, select the next higher 10-degree increment.) In this example the nearest whole number is 170 degrees; so, by dropping the zero from 170 degrees the figure 17 is produced. This number will appear on the approach end of the runway.

If the inbound magnetic heading of a runway is less than 100 degrees, such as 070, 080, 090, etc., the first zero and the last zero are dropped, resulting in runways numbered 7, 8, and 9. (See figure 8-2.)

At airports using multiple parallel runways L indicates left, R indicates right, and C indicates center. All numbers and letters are painted retroreflective white.

The runway centerline marking is a broken line with 120-foot dashes and 80-foot blank spaces. The minimum width of the basic runway centerline marking is one foot. The minimum width of the instrument runway centerline and the precision approach centerline marking is three feet, and the color is retroreflective white. (See figure 8-2.) At intersecting runways, the runway marking of the highest precedence is displayed, and the other runway markings are

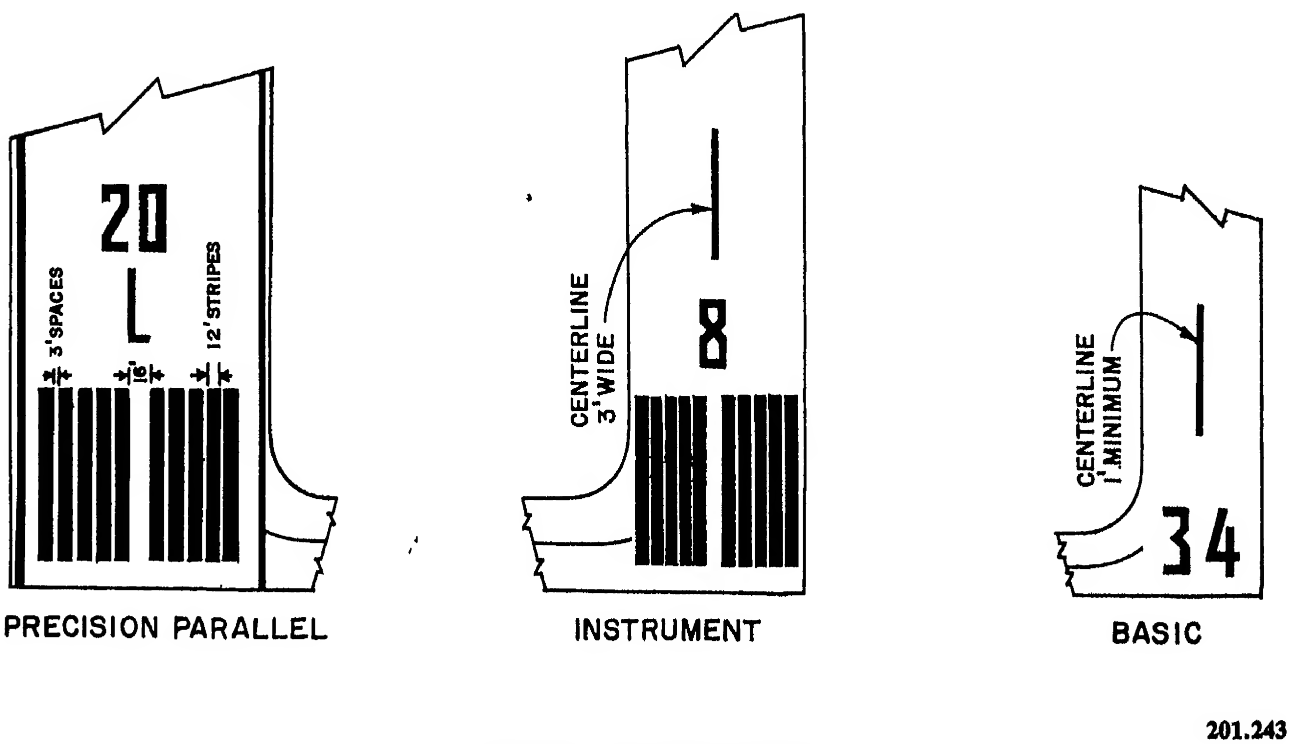

Figure 8-2.—Runway markings.

interrupted. The following is the order of precedence:

1. All-weather runway
2. Instrument runway
3. Basic runway.

To aid further in takeoff and landing guidance, there are runway side stripes on the precision runway. The painting specifications are the same as the centerline except that the side stripes are solid instead of broken. (See figure 8-2.) At intersections of two or more runways, the side stripes are continued on one runway only. Precedence for the continuous side strip is given to the primary runway.

RUNWAY THRESHOLD MARKINGS.—Runways 200 feet wide have ten stripes marking the landing threshold, each 12 feet wide by 150 feet long. These stripes are separated by 3 feet except the middle space, which will have 16 feet between stripes. (See figure 8-2.) For runways less than 200 feet wide, the threshold markings shall cover the width of the runway less 20 feet on both sides. Runways more than 200 feet wide shall have additional threshold stripes, still allowing 20 feet on both sides of the runway. The color for all threshold markings is retroreflective white.

DISPLACED RUNWAY THRESHOLD MARKINGS.—A displaced threshold is one that is not at the beginning of the full-strength runway pavement. Special markings are specified and shown in figure 8-3. Arrows 120 feet long with 80-foot spacing between arrows shall be painted on the unused end of the runway pavement pointing to the displaced threshold markings. The paint shall be retroreflective white. Other markings applicable to the type of runway will be placed on the usable side of the threshold markings.

RUNWAY DISTANCE MARKERS.—Runway distance markers are positioned on each side of the runway to inform pilots of the distance remaining on the runway in thousands of feet. Markers on the side of the runway shall be so located with respect to their companion markers on the opposite side. These markers shall be at right angles to the runway centerline. The first markers are placed 1,000 feet from the ends of the runway with the intervening markers at 1,000-foot intervals toward the midpoint of the runway. If the runway's length is in excess of

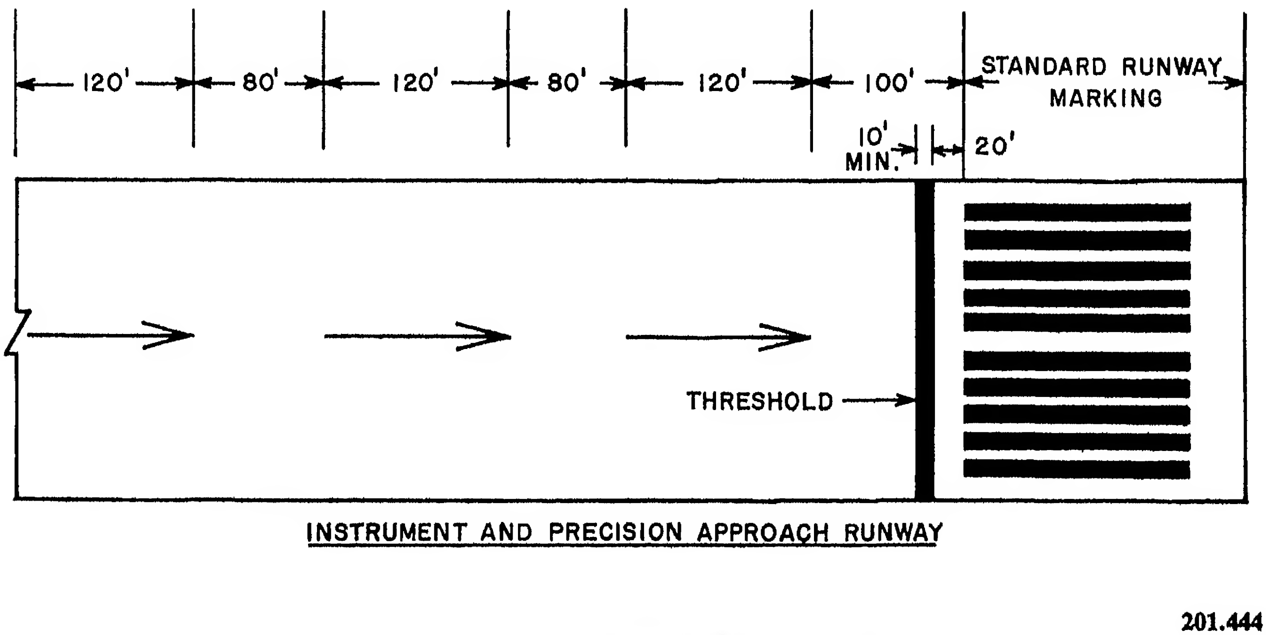

Figure 8-3.—Displaced runway threshold markings.

even thousands of feet, and the distance between the two midpoint markers is less than seven hundred feet, one of the distance markers is omitted.

All markers shall be located with the nearest edge 25 feet outboard from the edge of the full-strength portion of the runway, and always opposite a runway edge light. Markers which fall within 25 feet of an intersecting runway or taxiway pavement are omitted.

201.138

Figure 8-4.—Arresting gear signs.

ADDITIONAL RUNWAY MARKERS.—At some locations there are markings that are used for a specific purpose. One most common is an area used for field carrier landing practice (FCLP). In this instance an area is painted to simulate an aircraft carrier deck. Airports involved in testing new or modified aircraft sometimes require special markings in the course of conducting various tests. Fields that are used for pilot training may have certain markings arranged to better accomplish this task.

Large signs are installed on both sides of the runway to mark the location of arresting gear (discussed later in this chapter). The signs are large (7′6″ long) yellow plexiglass arrows with white letters on a black background. The signs are lighted. (See figure 8-4.)

Taxiway Markings

Taxiway centerline stripes, like runway markings, give visual aid to pilots. A noticeable difference between runway and taxiway markings is that white markings are used on runways, whereas taxiway stripes are indicated with retro-reflective yellow paint. Each taxiway is marked by a single centerline stripe 6 inches wide and continues onto the runway to the runway centerline (figure 8-5) except at runway ends as in figure 8-2.

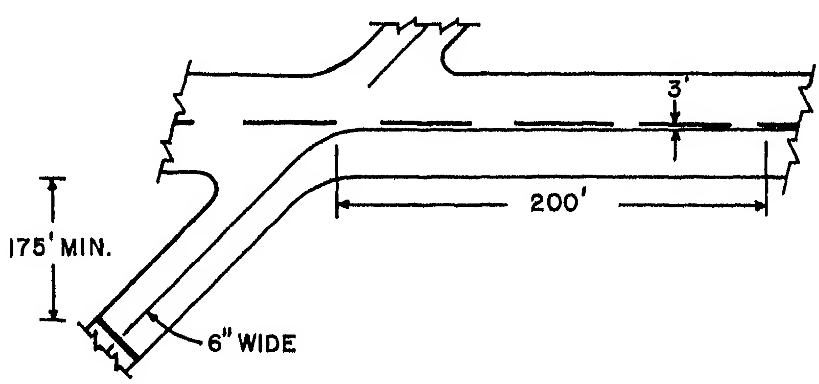

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Figure 8-5.—Taxiway/Runway intersection.

Holding line markers are also painted retroreflective yellow and consist of two solid lines and two broken lines. They are placed across the taxiway at right angles to the taxiway centerline, (see figure 8-5) except when the taxiway is associated with a warmup pad; then the holding line may be parallel to the centerline of the runway or taxiway which is intersected. These painted markings are used for holding aircraft 175 feet clear of the nearest runway edge. Ground traffic must not proceed beyond the holding line marker without a control tower clearance.

Another taxiway marking is the VOR/TACAN checkpoint. This location shall be marked by a 20-foot diameter circle painted on the taxiway centerline, as shown in figure 8-6. The circle shall consist of two concentric bands, the outer of white and the inner of chrome yellow paint, each six inches wide. An arrow shall be painted across the diameter of the circle pointing in the direction in which the aircraft is aligned for checking on-board high frequency omnidirectional and radio range (VOR) equipment. The arrow shall be painted white and chrome yellow in six-inch wide bands. There are usually several on an airport to facilitate ground checks regardless of the taxiway in use. (See figure 8-6.)

The checkpoint is used in conjunction with a VOR/TACAN check sign. The sign is made of lightweight material, using frangible supports, and placed 25 feet from the edge of the taxiway. It is painted with black lettering and has a hooded floodlight for night viewing. (See figure 8-6.) The hood is provided so that the vision of pilots will not be impaired during night

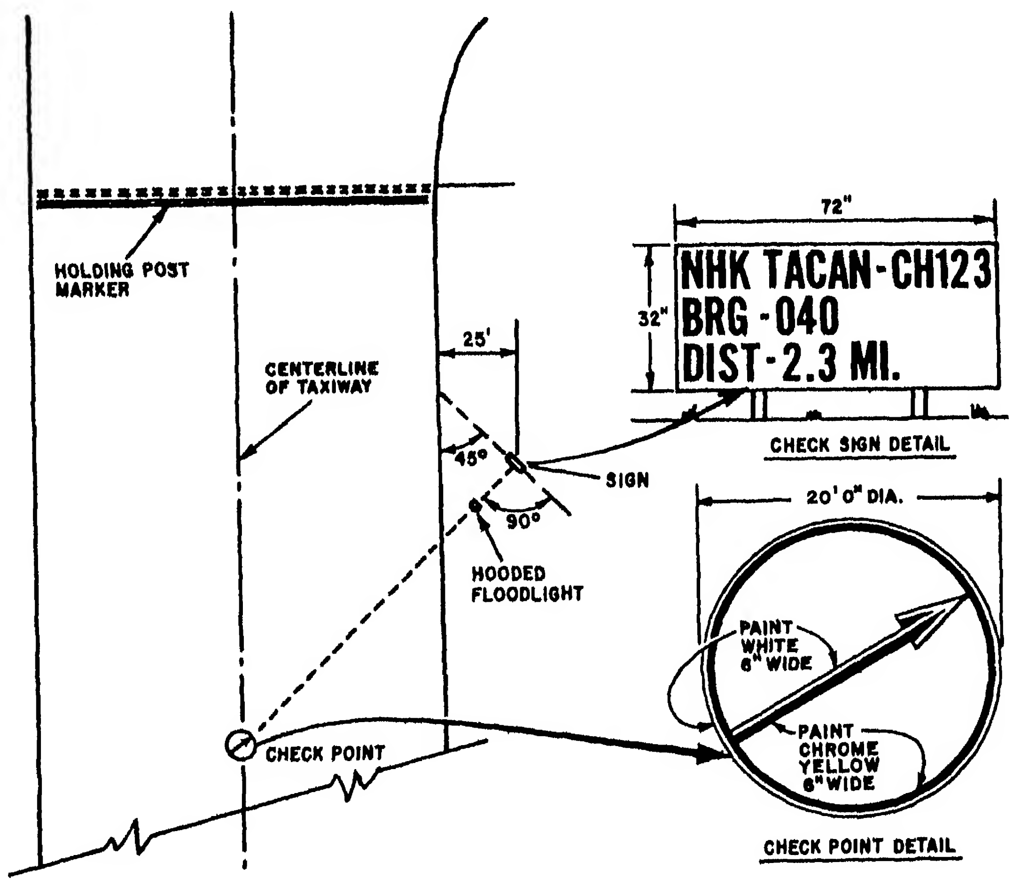

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Figure 8-6.—VOR/TACAN checkpoint and check sign.

operations. Newer electric signs are being put at air stations and are designed to operate in conjunction with taxiway lights. The information included on the sign is station identification, channel number or frequency, and magnetic bearing and distance to the VOR or TACAN station. The distance and bearing indicated are from the checkpoint, not the sign.

Deceptive, Closed, and Hazardous Area Marking

Where an operational requirement exists, there are provisions for marking deceptive, closed, and hazardous areas.

A deceptive area is any surface or area which appears usable but which, due to the nature of its structure, is not intended for normal operational use by aircraft. All deceptive and closed area markings are painted with retroreflective yellow paint, except in the case of a displaced threshold arrow and bar which is painted with retroreflective white paint.

A closed area may be a runway, taxiway, or any other area that was once used, but is no longer considered usable. It may be temporarily, such as during construction, or permanently closed.

An example of various markings of deceptive, closed, and hazardous areas, both overall and detailed descriptions, are presented in figure 8-7. Study this figure carefully in addition to reading the text.

A hazardous area is any permanent or temporary construction that presents a definite hazard to the operation of aircraft. Some examples are smoke stacks, antenna towers, buildings, and elevated tanks such as water supply tanks. When considered a hazard to flight, they are painted with aviation surface orange and white paint, normally in a checkerboard pattern.

A closed runway is marked with crosses composed of two yellow bands 10 feet wide and 60 feet long. These crosses are placed in the center of the closed runway, with no specified minimum distance between crosses, but they cannot be placed more than 1,000 feet apart. One cross is always placed near each end of the closed runway and adjacent to other runways and taxiways. At night, red lights in the shape of a cross are placed at the ends of the runway with enough lights to make certain the cruciform (cross-like) arrangement is clearly distinguishable.

A closed taxiway marking is similar to a closed runway marking; however, the crosses formed by the yellow bands, or red lights at

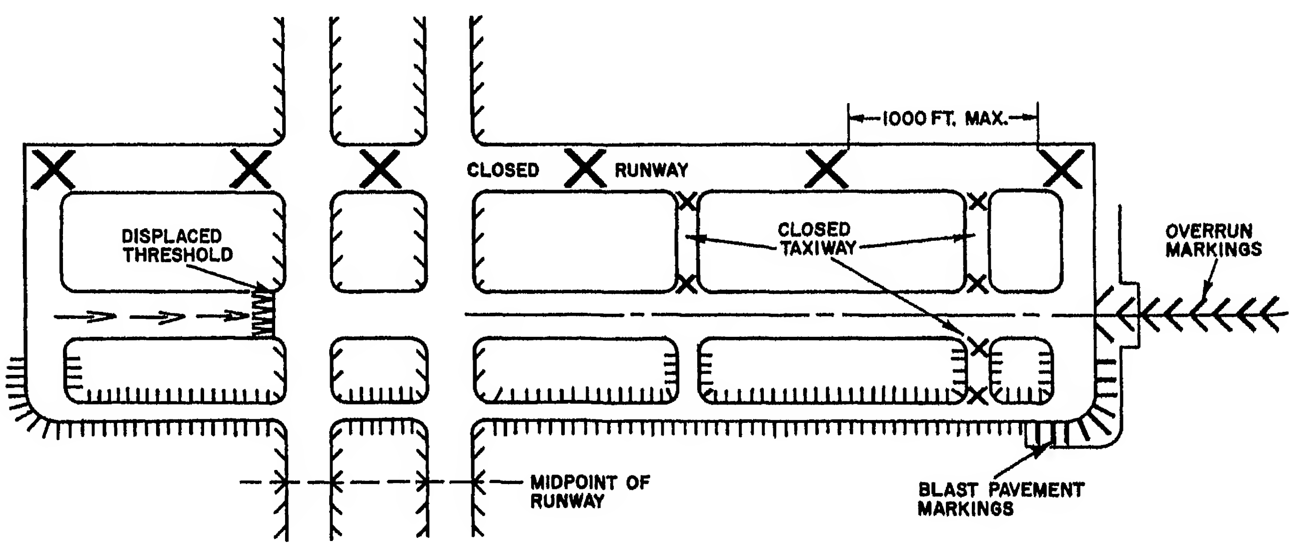

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Figure 8-7.—Marking of deceptive, closed, and hazardous areas.

night measure just half the size of the runway marking. They are always placed at or near the entrance of the closed taxiway. There is no set minimum or maximum distance between the crosses since each one in effect denies the use of the affected area. (See figure 8-7.)

Small holes, soft spots, etc., on the usable portion of landing fields, are marked by day with yellow flags or yellow pyramids and by night with red lights, to warn incoming pilots that the particular spots so marked are unsafe for landing. When overrun areas are paved they could be easily mistaken for a landing area. When this possibility exists, runway overrun markings are used. These are in the shape of chevrons painted retroreflective yellow, and the apex of the chevron points toward the runway. The stripes forming the chevron form a 45-degree angle from the runway centerline extended and are 3 feet in width. There is no specified minimum size of the chevron, but the overall dimensions cannot exceed 100 feet. They are placed on the paved overrun, along the runway centerline extended, 100 feet apart. (See figure 8-7.)

Runway, taxiway, and apron shoulder markings have much in common. All of these markings are painted nonretroreflective yellow with a 3-foot wide stripe beginning at the pavement edge, and placed 100 feet apart. Runway shoulder markings are placed at a 45-degree angle toward the approach end of the runway beginning at the runway midpoint. Taxiway and apron shoulder markings are perpendicular to the edge of the area. (See figure 8-7.)

Blast pavement markers are nonreflective yellow stripes 3 feet wide and 50 feet long. They are placed in areas where jet and propeller blasts should be directed when making engine runups at high power settings. Usually these markings are placed near the ends of runways. However, some areas may be established at other points on the airport specifically for maintenance checks. (See figure 8-7.)

Remember that deceptive, closed, and hazardous area markings are only used when and where they are needed. A particular airport may have all, some, or none of these markings.

For more illustrations and data relative to airport markings at naval airfields, you should refer to the following design manuals: NAVFAC DM-21, NAVFAC P-80, and NAVFAC P-272.

EXERCISE

8-1. State four factors which are taken into consideration when selecting a site for a new airfield.

8-2. When more than one runway is considered for an airport, what primary factor is used to determine the main runway?

8-3. What factors determine the length of the main runway?

8-4. The surface of the compass rose of a compass calibration pad is marked every how many degrees?

8-5. What letter(s) and number(s) appear on the approach ends of the northernmost parallel runway with a magnetic heading of 278 degrees? Note: Make a drawing to illustrate.

In answering exercises 8-6 through 8-14, select from column B the correct pavement marking used to identify the pavements listed under column A. The markings under column B may be used more than once or not at all.

COLUMN A	COLUMN B
8-6. Permanently closed runways	a. Retroreflective white lines(s)
8-7. VOR/TACAN checkpoints	b. Retroreflective white (solid line)
8-8. Taxiway shoulders	c. Retroreflective white (broken line)
8-9. Runway threshold	d. White and chrome yellow arrows
8-10. Arresting Gear signs	e. Retroreflective yellow (solid line)
8-11. Taxiway sidelines	f. Retroreflective yellow (broken line)
8-12. Displaced threshold	g. Nonreflective yellow lines
8-13. Runway centerline	h. Yellow Plexiglass arrows
8-14. Taxiway holding line	i. Large retroreflective yellow crosses
	j. Small retroreflective yellow crosses

FIELD LIGHTING SYSTEMS AND OPERATIONS

Procedures for the operation of airport lighting are outlined in FAA Handbook 7110.65. Operation of airport lighting is the responsibility of the control tower. During periods when the airfield is closed, all associated lighting shall be shut down with the following exceptions:

1. Navigable airspace obstruction lights as outlined in Federal Aviation Regulations Part 77 which are not associated with the closed airport.

2. Rotating beacons when used as a visual orientation aid in a metropolitan area.

Learning Objective: **Recognize standards applicable to airfield lighting systems and indicate functions of and operating rules for related components.**

Another operation with which you need to be familiar is the operation of the airport lighting system. Since the airport lighting system is controlled from the tower, you must know how and when to operate the various components. You might suppose that you turn everything on at sunset and off at sunrise, but such is not the case.

Airport field lighting systems have been standardized by the Air Force, Navy, and the FAA in order to present a uniform and unmistakable appearance. Flight personnel who are familiar with the adopted standards may readily interpret the lighting aids at any airfield. These standards specify the location, spacing, and color of lighting components in use.

A field lighting system is composed of runway lighting and other lighting aids with the necessary controls and power supply. All the lighting aids which could be installed are considered in this section even though their installation is decided by the mission of the airport.

AERONAUTICAL BEACONS

The aeronautical beacon is a visual aid displaying flashes of white and/or colored lights, which is used to indicate the location of airports, landmarks, and hazards to air navigation. The principal light used is a rotating beacon of relatively high intensity.

The color or color combination displayed by a particular beacon tells whether the beacon is indicating a landing place, a landmark, or a hazard.

Airport Rotating Beacons

The primary purpose of the airport rotating beacon is to identify the airport's location during darkness. It does have a secondary purpose, and that is during daylight hours to identify an airport as being below VFR weather conditions; therefore, it may be operated both day and night.

The rotating airport beacon has a vertical light spread to make it most effective at angles of one to three degrees above the horizontal from its site; however, it can be seen well above and below this peak spread. Rotation is in a clockwise direction when viewed from above. It is always rotated at a constant speed which produces the visual effect of flashes at regular intervals. Those flashes may be of one color or two colors alternately. The flashing rate for airport beacons is 12 to 15 flashes per minute.

Airport rotating beacons are located not closer than 750 feet to the centerline or centerline extended of the nearest runway and not more than 5,000 feet from the nearest point of the usable landing area.

Consideration should be given to ensure that the location of the beacon precludes the possibility of having a "dazzle" effect upon control tower personnel. To prevent this, the beacon shall be located at least 250 feet from the control tower and shall be a minimum of 20 feet above the elevation of the control tower cab floor.

The airport rotating beacon is operated continuously between sunset and sunrise. Operation of an airport rotating beacon during the hours of daylight means that the ground visibility in the control zone is less than 3 miles

and/or the ceiling is less than 1,000 feet and that an air traffic control clearance is required for landing, takeoff, and flight in the control zone.

The colors and color combinations of aeronautical light beacons and their meanings are as follows:

1. A rotating beacon showing alternating white and green flashes indicates that the beacon is at or within 2 miles of a lighted airport or landing field.
2. Military lighted airport rotating beacons display alternating white and green flashes, but the white flash has dual peaked (two quick) flashes to differentiate it from civil beacons.
3. A green coded beacon (not a rotating beacon) means that the coded beacon is located at or beside a lighted airport. When a rotating white and green beacon is located more than 5,000 feet from an airport or landing field, the green-flashing code beacon is used to show more exactly the location of the landing area.

Other Aeronautical Beacons

1. A rotating beacon displaying alternating white and red flashes indicates the location of a landmark or navigational point.
2. A rotating beacon showing red flashes alone indicates the presence of an obstruction or obstructions hazardous to air navigation.
3. Steady burning red lights are used near airports to mark obstructions, and are also used to supplement flashing lights in marking en route obstructions.
4. The normal (standard traffic pattern) flow of air traffic in the vicinity of an airport consists of left-hand turns. However, at some airports, right-hand turns are specified for various reasons; at these airports, a flashing amber light is installed at a prominent location on the field which indicates that a right traffic pattern is in effect.

RUNWAY LIGHTING

Runway Edge Lights

Runway edge lights form the outline of the runway for night operations. The runway lights are located along both sides of the runway, extending the entire length. Runway edge lights are spaced at even 200-foot intervals from each end toward the midpoint. For runways not evenly divisible by 200 feet, light spacing at the midpoint of the runway shall not be less than 100 feet. Runway edge lights are bidirectional white lights. The last 2,000 feet, or one-half of the runway length, whichever is less, is aviation yellow on instrument runways. Runway edge lights are elevated except at intersections where semiflush lights are used to maintain uniform spacing.

Runway edge lights are used to outline the edges of runways during periods of darkness and restricted visibility conditions. These light systems are classified according to the intensity or brightness they are capable of producing; they are: High Intensity Runway Lights (HIRLs), Medium Intensity Runway Lights (MIRLs), and Low Intensity Runway Lights (LIRLs).

Category A, B, and C naval airfields have high intensity runway lights (HIRL).

NOTE: For a listing of lighting, navigational, and communication requirements necessary for an airfield to be assigned a specific category, refer to the ATC Facilities Manual (OPNAVINST 3721.1).

The HIRL and MIRL systems have variable intensity controls, whereas the LIRLs normally have one intensity setting. The intensity or brightness of the runway lights can be varied by a selection switch on the lighting control panel in the control tower. There are five settings which may be selected with step 1 being the lowest and step 5 the highest. High intensity settings may be operated as prescribed by local procedures or as requested by a pilot for his operation. Table 8-1

Table 8-1.—High intensity runway lights settings

Step	*Visibility*	
	Day	*Night*
5	Less than 1 mile	When requested.
4	1 to but not including 2 miles	Less than 1 mile.
3	2 to but not including 3 miles	1 to but not including 3 miles.
2	When requested	3 to 5 miles inclusive.
1	When requested	More than 5 miles.

is a guide for determining the appropriate intensity setting.

Runway edge lights serving the runway(s) in use are operated at the specified setting shown in table 8-1. The procedures are as follows:

1. Between sunset and sunrise:

a. For departure. The lights are turned on when an aircraft calls for taxi instructions or requests that the lights be turned on. The lights are kept on until the aircraft reports departing the airport area or 15 minutes after the last contact with the aircraft.

b. For arrivals. The lights are turned on when the aircraft calls for airport advisory information or when the associated approach control advises that an aircraft is on approach. The lights are kept on until the aircraft reports or is observed clear of the runway or for 15 minutes after last radio contact or arrival time.

2. Between sunrise and sunset—turn the lights on in accordance with a and b above when the surface visibility is less than 2 miles.

NOTE: DO NOT turn on the runway edge lights when a NOTAM closing that runway is in effect.

In addition to 1 and 2 above, any time a pilot reports an emergency or when an emergency is suspected, immediate response is required. You must ensure that the pilot has appropriate and adequate runway lights or other applicable light systems where needed. For suspected inbound lost communications aircraft, the runway lights, approach lights, and other required light systems must be lighted as prescribed 30 minutes prior to the estimated time of arrival of the unreported aircraft. The lights must remain on until the aircraft has been reported located or 30 minutes after it is estimated that the aircraft's fuel supply is exhausted.

Threshold Lights

Threshold lights define the ends of the usable runway surface. They are used by the pilot at night to identify the end of the runway. Because of the many variations of lights required on each end of the runway, we are only discussing here airfields with VFR or Category "D" IFR capabilities. There are two groups of six lights each—one group on each side of the runway. The first light of each group is on line with the runway edge lights and spaced five feet apart. These lights are about two feet beyond the usable runway. (See figure 8-8.) They are bidirectional in color with green showing toward the approach zone and red toward the runway.

Runway End Identification Lights (REIL)

Runway end identification lights have a rotating mechanism which rotates two high-intensity lamps inside a clear glass cover at a constant speed of 40 revolutions per minute. The runway side of these lights is shielded to prevent glare from blinding the pilots of approaching aircraft. These lights are installed 50 feet outboard from each side of the runway edge in line with the threshold lights. (See figure 8-8.) REIL are operated when the associated runway edge lights are lighted.

Runway Centerline Lighting System (RCLS) and Touchdown Zone Lighting (TDZL)

Runway centerline lights, where installed, consist of a single row of lights at uniform intervals (25 feet apart) along the centerline of the runway to provide a continuous lighting reference from threshold to threshold. The lights are semiflush, bidirectional, and may be installed on a primary and secondary runway. On/off and brightness controls for individual runway centerline lights are provided in the control tower. Runway centerline lights are white from the threshold to a point 3000 feet from the runway end; alternating red and white from 3000 feet to 1000 feet from the runway end; and red from 1000 feet to the runway end. The intensity selected should be the same as that selected for the high intensity runway lights.

Touchdown zone lighting systems are used to indicate the touchdown zone area. These lights are recessed in the runway. They generally extend from 100 feet from the landing threshold to 3000 feet down the runway.

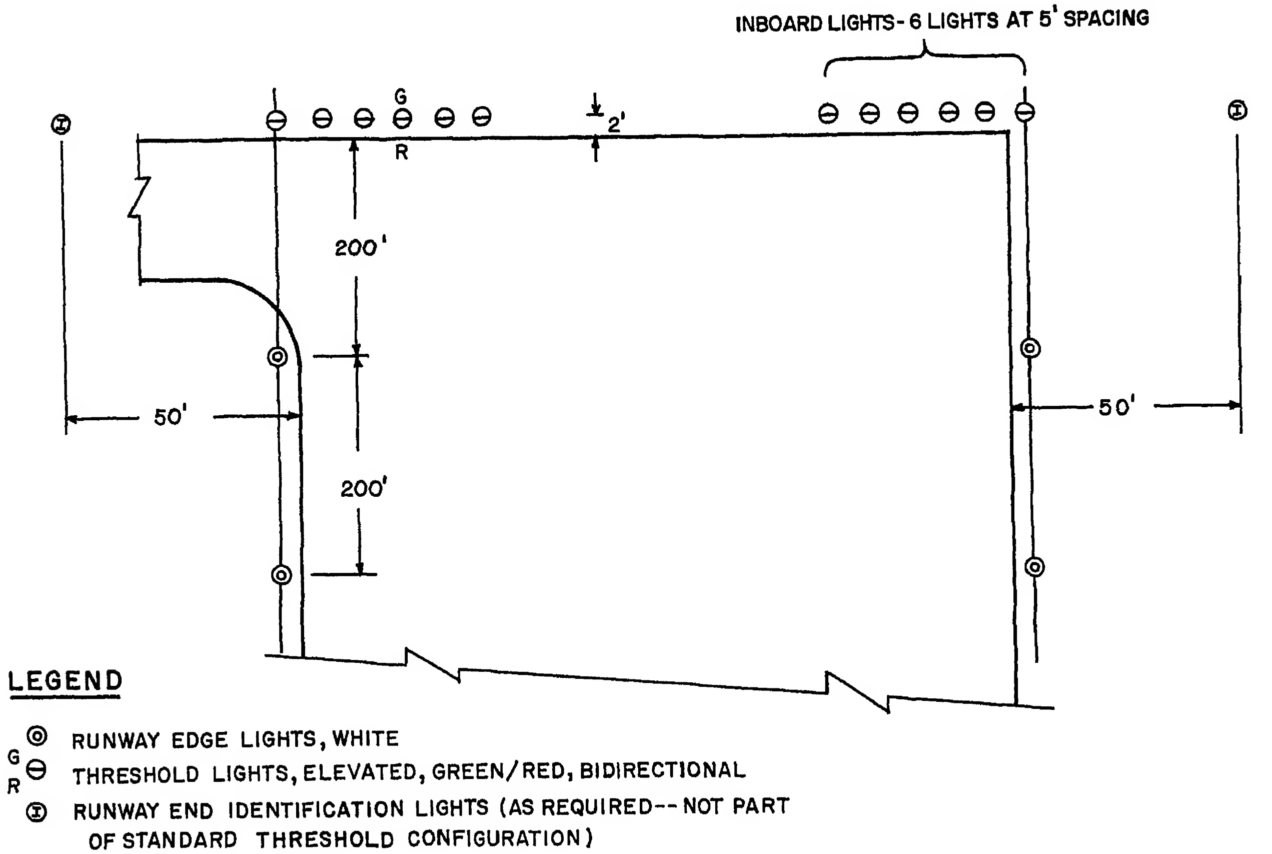

Figure 8-8.—Typical threshold lighting configuration.

Taxiway Lighting

Taxiway lights, which are blue in color, have a variable spacing distance, depending upon the length of a straight taxiway segment or radius of curve of a taxiway turn. On a straight segment over 300 feet in length, the space between lights may approach but not exceed 200 feet. On a straight segment of 300 feet or less, the distance between lights may approach but not exceed 50 feet. Taxiway lights marking a curved edge of a taxiway follow the rule that the sharper the radius of curvature, the closer the lights are placed. In no case will there be fewer than three taxiway lights on any one taxiway.

Two blue lights spaced 5 feet apart and placed on each side of a taxiway entrance into (or exit from) a runway or parking area are called entrance-exit lights. These lights are not installed at intersections of taxiways or at locations that are normally runway entrances or exits.

The control system for taxiway lights is designed to permit the lighting of combinations of individual taxiways necessary to provide any required lighted taxiing path. The taxiway lights are turned on as soon as the pilot of an aircraft is cleared to taxi out and turned off when the aircraft is on the runway or another taxiway. For inbound aircraft, they are turned on as the aircraft approaches the taxiway to be used and turned off when the aircraft is parked.

Approach Lights

Approach lights of varying types, colors, and construction have been specifically developed to meet civil and military requirements. These

lights are installed in an area extending outward from the threshold of the instrument runway, and are usually the pilot's first visual contact with the ground under extremely low visibility conditions. Electronic landing aids, such as GCA and ILS, are used to bring the pilot down to the approach minimums. Approach lights are required for final alignment with the runway, and runway lights are required to complete the landing.

High-intensity incandescent lights penetrate somewhat farther through fog, smoke, or rain than neon lights. Several types of high-intensity approach lights have been installed in the United States, taking the place of the neon system.

The current system being installed at Navy facilities is called Centerline Approach Lighting System (U.S. Standard (A)). It consists of a series of crossbars of lights (normally 3,000 feet) with condenser discharge (sequence flashing or strobe lights) centerline lighting that coincides with the runway centerline lighting, and indicates the approach to, and threshold of, the runway. The intensity of the approach lights can be varied from the control tower. To be most useful, the lights must be bright enough to penetrate the overcast effectively without blinding the pilot or producing halo effects. Different intensity settings are needed for day and night use. The operation and intensity setting selected may be determined by local procedure and instructions. Table 8-2 is a guide for determining the appropriate approach lights intensity settings.

The sequenced flashing lights are controlled independently of other lights and are either on or off. They are, however, a component of the approach lights and, therefore, the approach lights must be on before the sequenced flashing lights will operate. Operate the lights when:

1. The ceiling is below 1000 feet or the visibility is less than 3 miles and approaches are being made to the runway served by the associated approach lights.
2. As requested by the pilot.

NOTE: Be alert during periods of low visibility and fog because often the pilot will request "strobes off" on short final. This is because of the blinding effect the lights have when rebounding off the fog.

Table 8-2.—High intensity approach lights settings

Step	*Visibility—(Applicable to runway served by lights)* Day	Night
5	Less than 1 mile*	When requested.
4	1 to but not including 3 miles	When requested.
3	3 to but not including 5 miles	Less than 1 mile.*
2	5 to but not including 7 miles	1 to 3 miles inclusive.
1	When requested	Greater than 3 miles.

* and/or 6,000 feet or less of RVR on the runway served by the ALS and RVR.

The various configurations of approach lighting systems available to pilots today can be found inside the back cover of the Low Altitude Instrument Approach books.

MISCELLANEOUS AIRPORT LIGHTING

Visual Approach Slope Indicator (VASI)

VASI is designed to provide by visual reference the same information that a glide slope of an ILS provides electronically. It provides a 2 1/2- to 3-degree visual glide slope within the approach zone which a pilot can see and use for descent guidance during an approach to a landing.

The VASI system is primarily intended for use during VFR conditions, day and night.

The standard installation consists of 12 light source units arranged in light bars of 3 units placed on each side of the runway opposite the 500-foot mark, and three units on each side of the runway opposite the 1,200-foot mark. (See figure 8-9.) Each light unit projects a beam of light having a white color in the upper part and a red color in the lower part. The light units are so arranged that the pilot, during an approach,

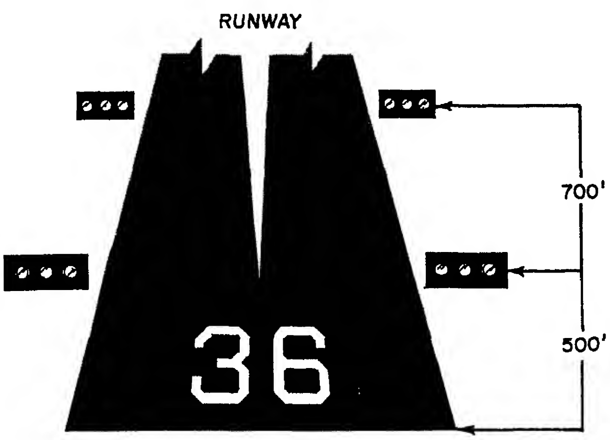

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Figure 8-9.—Visual approach slope indicator.

would see one of the combinations shown in Table 8-3.

The intensity of the VASI system is controllable at some installations while at others the intensity is controlled by an electronic device. Where controllable, the controls are located in the tower as is the on/off switch. Normally, the VASI system is left on at all times; however, local procedure and instructions may require otherwise.

Table 8-3.—VASI glide slope presentation

Aircraft Position	Presentation
Above the glide slope	white white
On the glide slope	red white
Below the glide slope	red red

Wheels-Up/Runway Waveoff Lights

Several different visual waveoff methods may be in use at naval air stations, including hand-held flags for the runway wheels watch, where used. The waveoff lights on the Optical Landing System (OLS) and the wheels-up waveoff lights are the principal systems in use and, where installed, shall be interconnected and controllable from the control tower as well as runway location(s). Both systems shall be operable from a single control. Waveoff lights will be used by tower personnel and Landing Signal Officer (LSO), as appropriate, to augment radio transmissions when a waveoff is required. Waveoff lights are designed for intermittent use only and are not to be used to signal a closed runway. Prolonged use of the lights will cause transformer failure and undesired loss of the system.

One wheels-up/runway waveoff light system consists of six clusters of three red lights located on each side of the runway starting about 900 feet from the runway threshold and spaced about 800 feet apart. Additionally, a wheels-up light bar is located about 1,000 feet outboard of the runway threshold on the same side of an imaginary extension of the runway as the control tower. (See figure 8-10.)

The lights face landing aircraft and are turned in toward the runway centerline. The lights can be controlled from the wheels watch Landing Signal Officer (LSO) position or from the control tower. When activated, a flashing device causes the lights to flash 90 times per minute with equal on and off time.

Obstruction Lights

Obstruction lights are located on all elevated obstructions on the airport and on all other obstruction within a given glide angle of an airport. They are red in color and are lighted from sunset to sunrise and during daytime when flight visibility is restricted.

Optical Landing System (OLS)

Many facilities have a Fresnel lens optical landing system installed along the side of a heavily used runway for use in field carrier

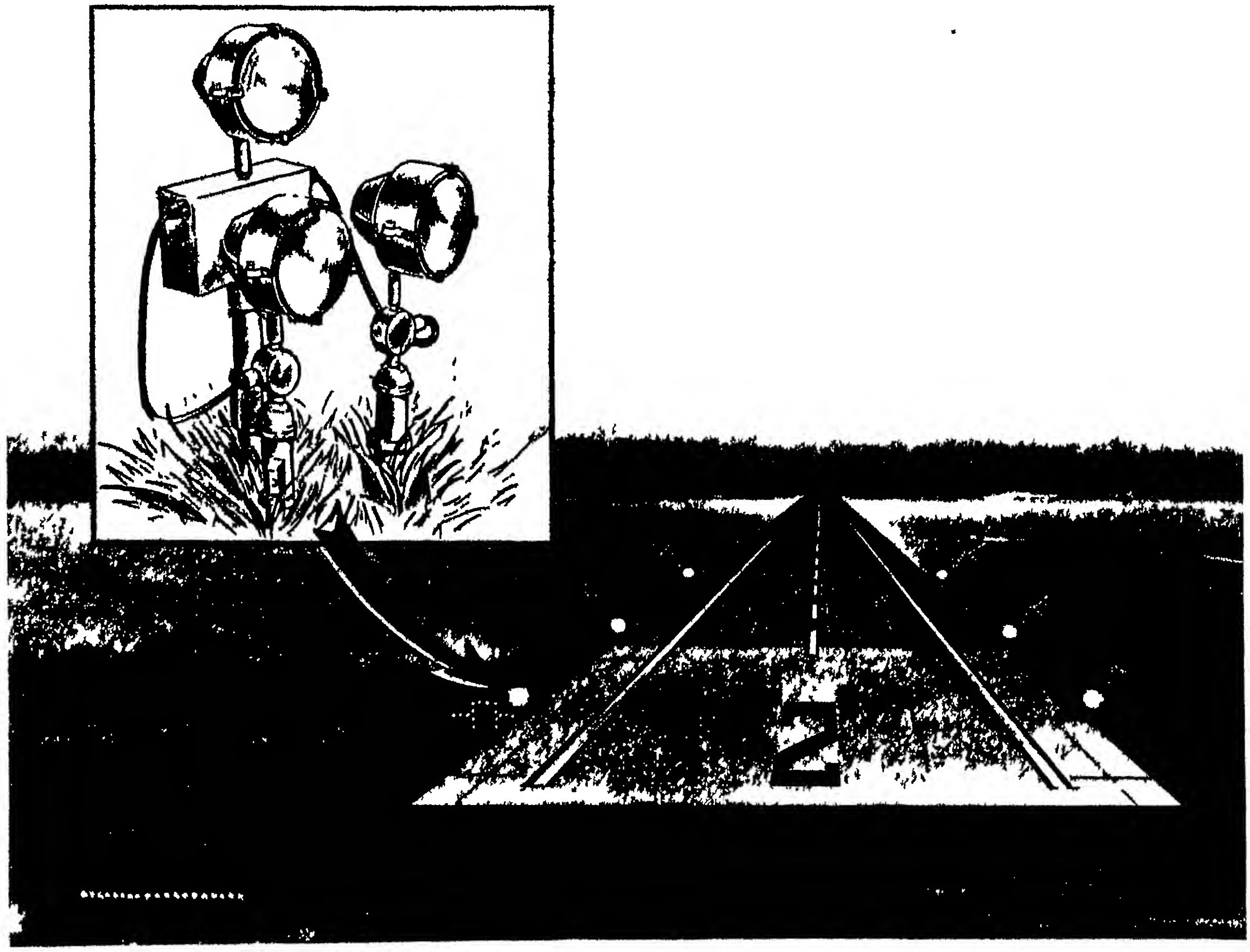

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Figure 8-10.—Wheels-up/runway waveoff lights.

landing practice and for pilots to keep proficient using this type of landing approach. The OLS is normally turned on at all times the associated runway is in use.

Although the physical build of the shore-based lens may differ from the shipboard lens, the view presented to the pilot is the same in either case.

The Fresnel lens is discussed in detail in chapter 14 of this Rate Training Manual.

Wind Indicators

Wind tees, tetrahedrons, and wind cones are classified as wind indicators and need not be controllable when so used. The wind tee (figure 8-11) is lighted to provide continuous day and night indication of wind direction. The wind tee is capable of swinging in a 360-degree circle, subject only to the wind. The wind tee is located as near as practicable to the center of the runway layout configuration. It shall be sufficiently remote from large structures to give a true wind direction. Because of its size and weight, the wind tee shall not be located where it presents a possible obstruction hazard to flight operations.

The wind tee is similar in outline to a small aircraft. It is mounted on a pedestal and will

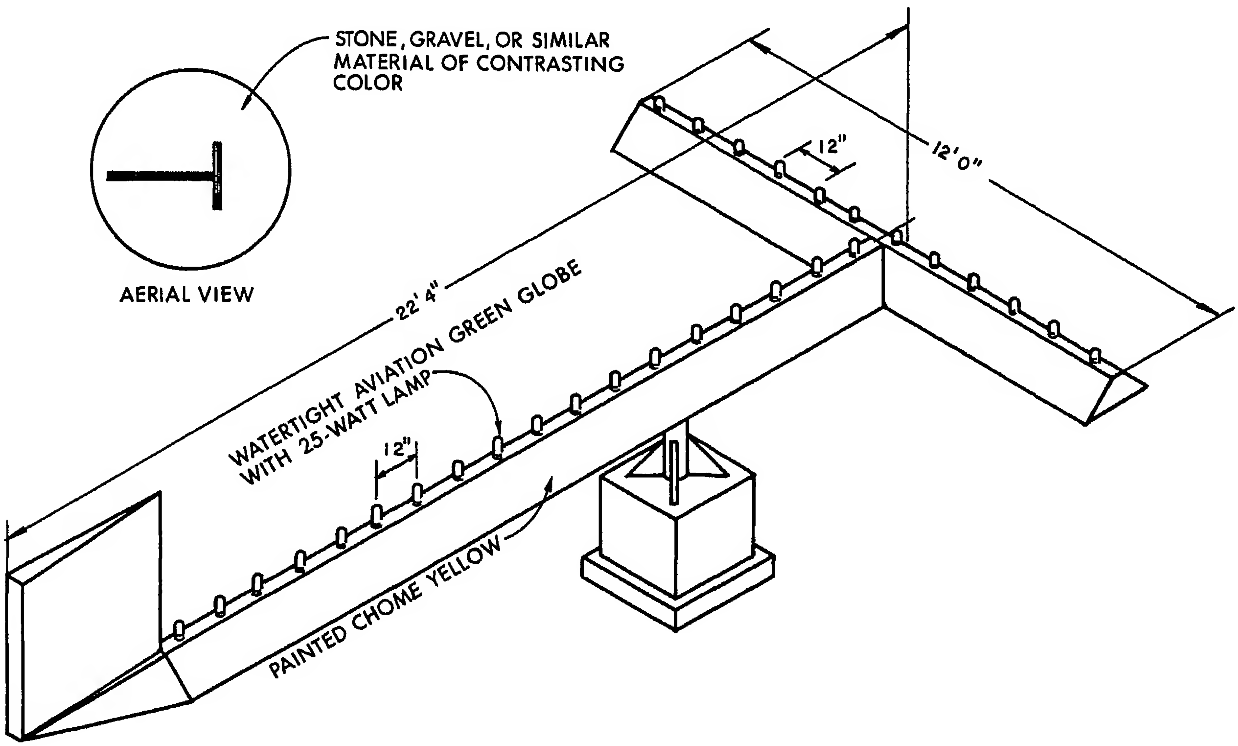

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Figure 8-11.—Wind indicator (wind tee).

weathercock into the wind, thereby indicating the wind direction. This free swinging characteristic affords the pilot a visual presentation of the exact direction from which the wind is blowing. If the tee is not aligned perfectly with the runway being used, the pilot knows that he has to compensate his landing for a crosswind—the amount of compensation being roughly judged from the angle the tee is deviating from the centerline of the landing runway. Also, while taking off it is expedient for the pilot to have this same information.

The wind tee body and base shall be painted solid chrome yellow and lighted with thirty green lights to form a "T" when viewed from the air. A contrasting background (a 100-foot circular background) consisting of a crushed stone, gravel, or similar material shall be used to retard the growth of vegetation, and spray-painted to provide a sharp contrast to the wind tee coloring.

The tetrahedron is the largest of the wind indicators. The ideal location for this indicator is at a site easily visible from the ends of all runways. A 100-foot circular background of contrasting color, under the tetrahedron, increases the visibility of this indicator.

The tetrahedron is outlined at night by green lights on the starboard side and red lights on the port side, with green lights along the central ridge and spar. (See figure 8-12.) Tetrahedron lights flashing between sunset and sunrise indicate that the ground visibility is less than three miles or the ceiling is less than 1,000 feet, or both. Normally, when this condition exists, VFR operations are suspended and IFR operations are placed into effect. Not all airports are equipped with tetrahedrons and not all tetrahedrons are equipped with flashing lights.

Wind cones are normally installed at the approach end of all runways and provide the

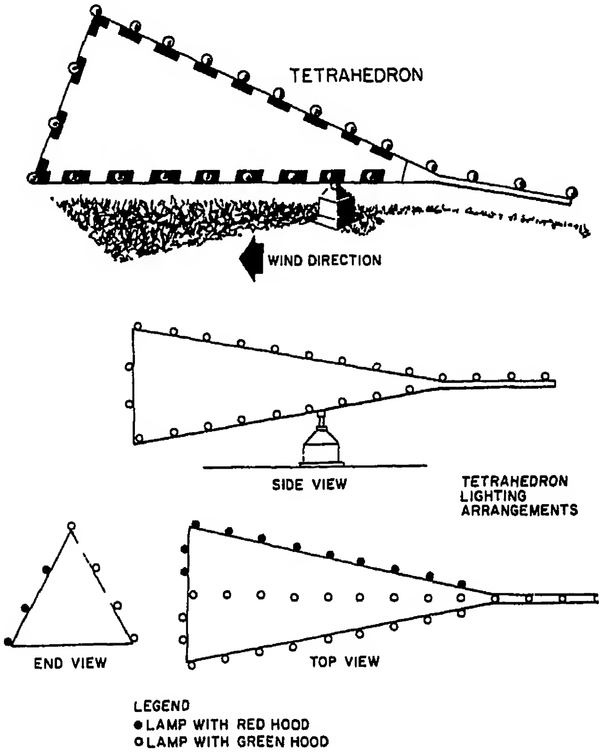

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Figure 8-12.—Wind indicator (tetrahedron).

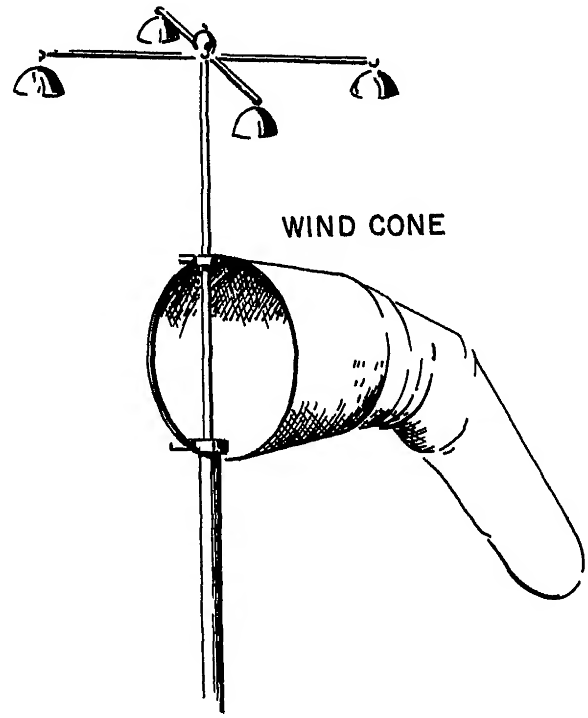

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Figure 8-13.—Wind indicator (wind cone).

pilot with wind data for that particular point on the airport. (See figure 8-13.)

The wind cone has the appearance of a large stocking minus the foot. It is made of light, durable fabric and is secured to a mast by means of a swivel on the hoop at the large end. Air in motion passing through the wind cone aligns the wind cone with the wind to indicate the direction from which the wind is blowing. The wind cone has an advantage over the wind tee in that besides indicating the direction, it also gives an approximation of wind velocity.

The velocity of the surface wind can be approximated by comparing the angle of the wind cone in its relation to the ground. The wind cone will stand out parallel with the ground when the wind is 15 to 20 knots. (A steady wind greater than 20 knots will give the same indication; hence, caution must be exercised if the wind cone is the only available reference.) A gusty wind is indicated when the windcone alternately rises and falls rapidly. A calm wind is indicated when the wind cone hangs limply at the mast. Gusty, shifting wind is denoted by the wind cone swinging from side to side and rising and falling.

The type of fabric from which the wind cone is constructed determines to a great extent how high it will rise in a given wind velocity. Thus, the fabric should be a standard type for all wind cone construction in order for consistent approximations of wind velocities to be made. The wind cone may be lighted for nighttime use.

Airport Course Lights

Some military airports have special light signals, such as course lights, which indicate landing direction, runway in use, traffic pattern in use, and other similar information for local activities. These lights are to be used as directed

by the commanding officer. The principal advantage in using the course lights is that it gives pilots pertinent and specific visual information; therefore, radio contact with the control tower is unnecessary. However, the meaning and arrangement of these lights have no standardization and are used only for pilots known to be familiar with the meaning of the special light signals.

For more detailed information on airfield lighting and traffic aids refer to the Design Manuals, "Airfield Lighting" and "Navigational and Traffic Aids" (NAVFAC DM 23.1 and DM 23.2).

EXERCISE

8-15. What branch of an Air Traffic Control Facility is responsible for the operation of airport lighting systems?

8-16. How is a military airport differentiated at night from a civil airport?

8-17. Assume that it is 2 hours after sunrise and you are working the tower local control position. An aircraft is making an approach to runway 21. The official sky and visibility is 20 BKN E50 OVC 2H. Since runway 21 is the runway of intended landing, and it is equipped with approach lights, do you turn on the approach lights? Explain your answer.

8-18. In this same instance, should the sequenced flashing lights be on or off? Explain.

8-19. Also in this same instance, should the runway edge lights be on or off? Explain.

8-20. Based upon the following sky and visibility report: 15 SCT 30 SCT E55 BKN 4H, should the rotating beacon be on or off, if it were during daylight hours? Explain.

8-21. Name the three wind indicators in use at most naval airfields.

8-22. What lighting system is used to indicate that a field is IFR between (a) sunset and sunrise, (b) sunrise and sunset?

MISCELLANEOUS AIRFIELD EQUIPMENT AND EMERGENCY SYSTEMS

OPNAV Instruction 3721.1 (Series) sets forth a basic outline for preparing standard air operations manuals. These manuals are prepared locally under the supervision of the commanding officers of the airports, and they must be signed by the commanding officers.

These manuals contain specific information and instructions for the control of aircraft and aircraft handling equipment in use at the airport, instructions relating to transient aircraft and personnel, and procedures for crash and rescue. The operations manual should be read and understood by all ACs soon after reporting to a new duty station so as to become familiar with types of local operations and facilities.

Learning Objective: **Identify the different types of emergency recovery equipment and their uses.**

MOBILE COMMUNICATIONS/CONTROL VANS

Some ATC facilities possess a mobile control tower or radio communications van which may be used to provide temporary operating facilities for the Air Traffic Controller when the need arises.

These units may be used during periods of equipment outages in the main control tower; to provide coordination with the LSO (Landing Signal Officer) during times that field carrier landing practice (FCLP) is being conducted, or

when special aircraft operations or test/evaluations are being accomplished on the field which require coordination with the controllers in the primary control tower.

The mobile communications van (AN/MRC-131) shown in figure 8-14 is equipped with UHF, VHF, and FM radios which are operated from inside the cab of the vehicle. This unit also has provision for a remote station for outside operations.

The mobile control tower, AN/GRC-100 (figure 8-15), contains an auxiliary power unit (APU) or 24-volt battery which provides the necessary power to operate the equipment.

Equipment contained in this unit generally consists of UHF, VHF, and FM radios, wind indicator, portable traffic control light, clock, interior lights, and other associated gear.

Generally speaking, the mobile control tower provides the controller with enough equipment to perform his duties in a satisfactory manner, especially during a period when traffic conditions are relatively light.

If your station is equipped with a mobile tower or radio van, you should make every effort to become familiar with the equipment installed in it and become proficient in its operation.

EMERGENCY POWER

Responsibility

Commanding officers are responsible for developing and maintaining plans and procedures for ensuring continuity of air traffic control services and navigational aids during emergency conditions such as power failure, fire, flood, storm damage, etc. In this regard, auxiliary power sources must be maintained in

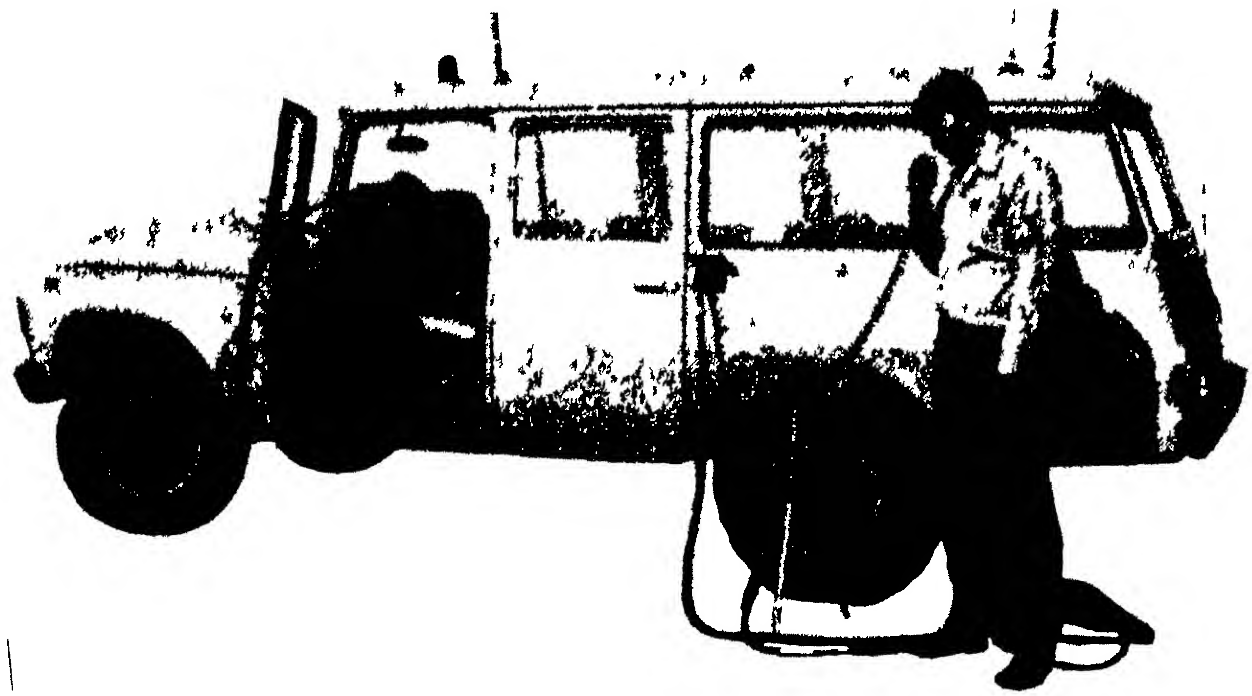

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Figure 8-14.—Mobile control facilities. AN/MRC-131 mobile radio communications van.

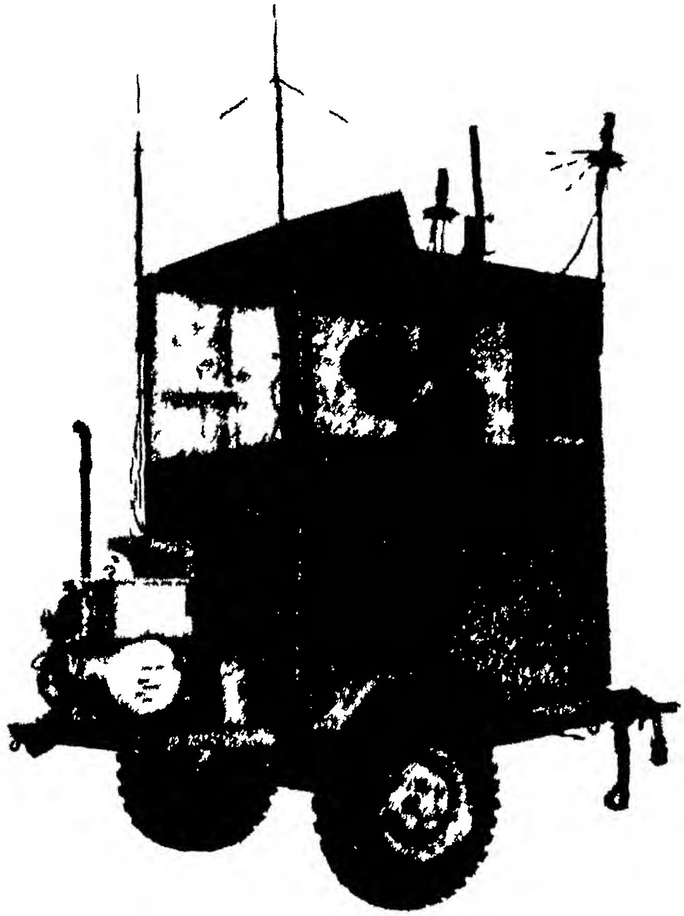

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Figure 8-15.—Mobile control facilities. AN/GRC-100 mobile control tower.

optimum operational condition. Accordingly, each ATC facility establishes a program of preventive maintenance and periodic load and no load operation to ensure maximum continuity of ATC service.

Severe Weather Activity

Weather reports, advisories, and radar shall be monitored to determine when severe weather activity is approaching the facility. At least 30 minutes before severe weather is anticipated, facilities shall shift to auxiliary power unless reliable automatic transfer equipment is installed. Auxiliary power generators for related facilities including navigational aids shall be operated as directed by the ATCF Officer.

EMERGENCY AND CRASH PROCEDURES

The facilities for fighting fires and aiding personnel involved in crashes are a vital part of the airport equipment.

While flight operations are being conducted, commanding officers must ensure that adequate firefighting, crash, rescue, and ambulance equipment is on hand. They must also see that the equipment is favorably located, adequately manned, and in efficient operating condition

and the crew is alerted. Only a minimum of equipment is required on the field during normal operations, but other crash and rescue equipments are held in readiness at all times.

All air stations maintain a current crash bill detailing the duties of those assigned the handling of such emergencies including control tower operators. The Crash/Search and Rescue Bill is contained in the station's Air Operations Manual. Additionally, procedures are established for handling emergencies or accidents when the aircraft involved is carrying hazardous cargo. These instructions are normally separate from the crash bill because of their classified nature.

It is the primary responsibility of the control tower operator to observe closely all activities on the airfield and within the visible traffic pattern, and maintain radio communications with aircraft concerned. Normally the control tower operator obtains initial information on an impending emergency or accident. Control tower personnel must speedily convey exact information to crash, firefighting, and rescue units so that prompt action by those units can be taken.

Primary Crash Alarm Intercommunications System

This system is a direct wired intercommunications system normally installed between the stations listed below.

Its purpose is to provide an immediate means of communication to primary emergency activities so they may notify all essential supporting activities.

1. Control tower.
2. Crash/rescue alarm room.
3. Air operations dispatcher.
4. Structural fire alarm room.
5. Air operations duty office.
6. Station hospital or dispensary.

Secondary Crash Alarm Intercommunications System

This system may operate through the regular telephone switchboard and may be activated from the control tower and the flight clearance desk. This system is referred to as the "crash phone." Telephone receivers on this system are installed as required at each facility. The following stations are suggested:

1. Crash/rescue alarm room.
2. Structural fire organization.
3. Hospital or dispensary.
4. Aircraft maintenance department.
5. Photographic laboratory.
6. Crash boat house (if applicable).
7. Security office.
8. Airfield operations office.

This system allows notification of all essential personnel and activities simultaneously by the flight clearance dispatcher without further interference with control tower duties.

The "crash phone" is tested daily at all facilities to ensure its satisfactory operation. This test is usually originated by the control tower of the flight clearance branch.

As procedures may vary at different ATC facilities, no attempt is made here to explain actual test procedures; however, you should become thoroughly familiar with the entire operation of the crash phone system as it pertains to your facility.

Emergency Radio Communications Systems

Two radio networks are provided for the purpose of coordinating crash and firefighting activities. The primary network is referred to as the "crash network" which provides communications between the control tower and the necessary mobile units such as crash trucks and ambulances. The other network is a standby or spare in case of outage of the primary equipment. The secondary network is referred to as the "internal security network."

Responsibility

In the event of a crash or impending emergency, control tower personnel must convey exact information to the necessary units concerned and keep them advised of the status and pertinent details. They must notify all traffic on the field and in the air of the crash or emergency, and, at the direction of the operations officer or his authorized representative, close

the field to traffic until free for normal operations.

When activating the crash phone system, give the following information if available:

1. Location.
2. Type of aircraft.
3. Nature of emergency.
4. Fuel state.
5. Number of personnel aboard.
6. Explosives, ordnance stores, or other dangerous cargo.
7. Landing runway and ETA.
8. Any other pertinent information.

Aircraft crashes are usually described as to location by using a grid map system especially constructed for this purpose. (See figure 8-16.)

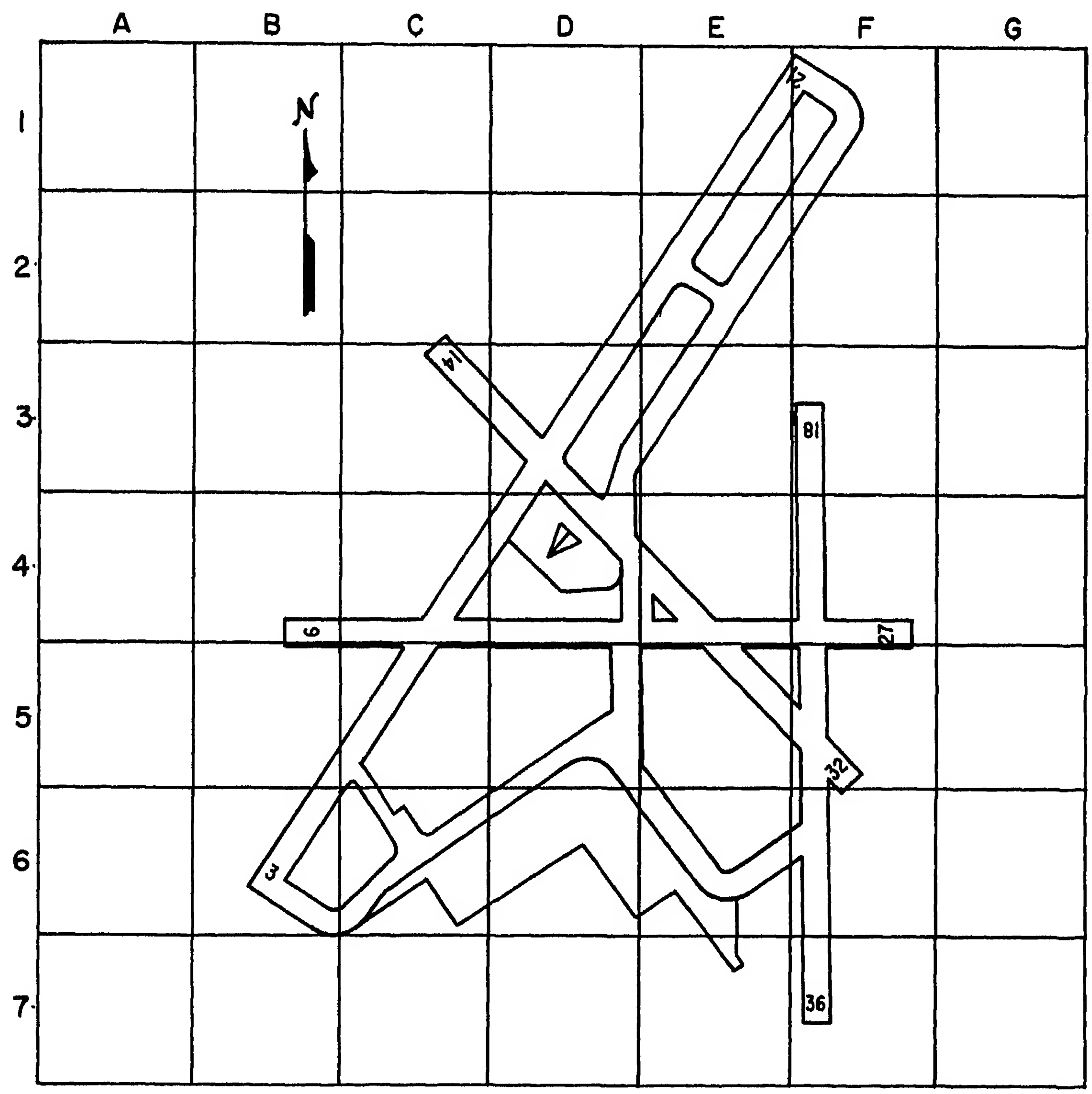

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Figure 8-16.—Crash grid map.

Sometimes it is desirable to construct two grid maps. One map is used for crashes on or near the airport, and one is expanded to cover more area for off-station crashes. In either case, all crash vehicles, crashboats, and rescue aircraft must be supplied with copies of these maps to be able to interpret tower directions. Two examples in using this map are: Area THREE FOXTROT would indicate the approach end of runway 18 and SIX BRAVO would indicate the approach end of runway three.

There is a certain amount of excitement generated with the occurrence of an emergency or crash. However, since you are transmitting very vital information it is extremely important that you be CORRECT, CONCISE, and CALM. Remember that you are talking to several people at one time and they must absorb the information that you are giving in order to take proper action.

Emergencies and crashes more distant from the field are usually handled by search and rescue facilities.

For detailed information pertaining to the organization and duties of the crash crew, you should consult the *U.S. Navy Aircraft Firefighting and Rescue Manual* (NAVAIR 00-80R-14).

Preventing Wheels-up Landings

There are many and varied reasons for wheels-up landings. They range all the way from mechanical failure of the landing gear system to forgetfulness on the part of the pilot.

In order to keep wheels-up landings at a minimum regardless of the cause, most naval air stations post a wheel watch at the approach end of the duty runway. This watch is normally provided with two LSO paddles or flags and a pyrotechnic flare pistol or a control switch to the wheels-up warning lights (discussed earlier in this chapter) where installed.

The duty of the wheel watch is to closely observe each aircraft approaching for a landing; if the landing wheels appear to be down and in place, he signals a ROGER (arms extended parallel to the ground). A waveoff (signal not to land) is given to all aircraft not having landing gear extended (wave arms overhead to side).

At any time there is any doubt, the wheel watch gives a waveoff. If the aircraft continues, and it becomes apparent that the waveoff signal has not been observed, pyrotechnic flares are fired or the wheels-up warning lights are activated, if applicable.

EMERGENCY RECOVERY EQUIPMENT

Emergency recovery equipment is installed at naval airfields to provide a means of bringing tailhook-equipped aircraft to a safe stop after landing whenever normal landing procedures cannot be employed.

This method of recovery may be utilized by aircraft that have experienced a partial failure of their hydraulic system, thereby resulting in a possible loss of brakes, and quite frequently the inability to lower part or all of the landing gear—also in the event of a blown tire or for any other reason that the pilot would deem it advisable to make an arrested landing. Visual inspection of the landing gear or tail hook may also be accomplished by other aircraft in your area.

When an emergency arrestment is planned in advance, controllers should be alert to ensure that the tailhook is actually down prior to engagement with the arresting cable.

This may be accomplished by a visual sighting of the hook itself during daylight hours and by observing the sparks generated by the hook dragging on the runway during night landings.

The most common aircraft arresting systems employed at naval air stations are discussed in this section.

E-5 Emergency Chain-Type Arresting Gear

The chain gear is mostly used as an overrun backup arresting system. The E-5 chain-type emergency arresting gear uses the principle of dragging weight behind an aircraft to stop it. The weight in this instance is chain that has been positioned on the runway parallel to and approximately one foot inboard from the edges. Two cross deck pendants (cables stretched across the runway) attached to the ends of the chain permit aircraft to be arrested by the tailhook

catching the cross deck pendant and dragging the chain until the aircraft comes to a stop.

The chain gear consists of two cross deck pendants, two lengths of chain, and the necessary equipment to tie the two together to make the arresting gear unit.

The operation of the chain gear is very simple. The aircraft catches one of the cross deck pendants with its tailhook, and at this time the shearpin is broken. This released the pendant, which is now connected only to the chain. The chain is then towed down the runway by the aircraft. (See figure 8-17.) This permits the transfer of the energy of the arrested aircraft to the chain. The arrangement of the chain causes it to pay out gradually, thus progressively increasing the weight pulled by the aircraft. The energy of the arrested aircraft is dissipated by the chain until the arrestment is completed. Then the aircraft is disengaged from the gear, and the gear is restored for future use.

E-28 Emergency Runway Arresting Gear

The E-28 arresting gear is a rotary hydraulic system. It is fast and efficient, and needs little maintenance. It can arrest hook-equipped aircraft in all types of landings. The simplicity of the gear's structure, and its high caliber reliability, make it exceptional. The cycle time for reuse is approximately 80 seconds. No initial preparation or adjustments are necessary for arresting any type of naval aircraft. A person can usually qualify to operate the E-28 within a day or so. Figure 8-18 is an example of the E-28 installation. It is anticipated that the E-28 will eventually replace all other types of arresting gear ashore.

Basically, the E-28 includes a rotary hydraulic system with two identical arresting engines that control the play out of a cross-deck pendant held by the nylon tapes that feed into a winding drum mechanism attached to each energy absorber unit. Each system also contains a cooling system and a retrieve system. Once the hook engages the pendant, the forward motion of the aircraft pulls out the nylon purchase tape and activates the energy absorber units. Each absorber unit has a rotor and an arrangement of stationary vanes in a container of hydraulic fluid. As the tape unwinds, the rotating wheel turns the rotor, thus creating turbulence in the fluid. This turbulent fluid offers such resistance against the rotor that the speed of the unwinding wheel reel diminishes to the point where the play out of tape is stopped. The heat generated by resistance of the turbulence is drawn off by the pumping of the hydraulic fluid through a

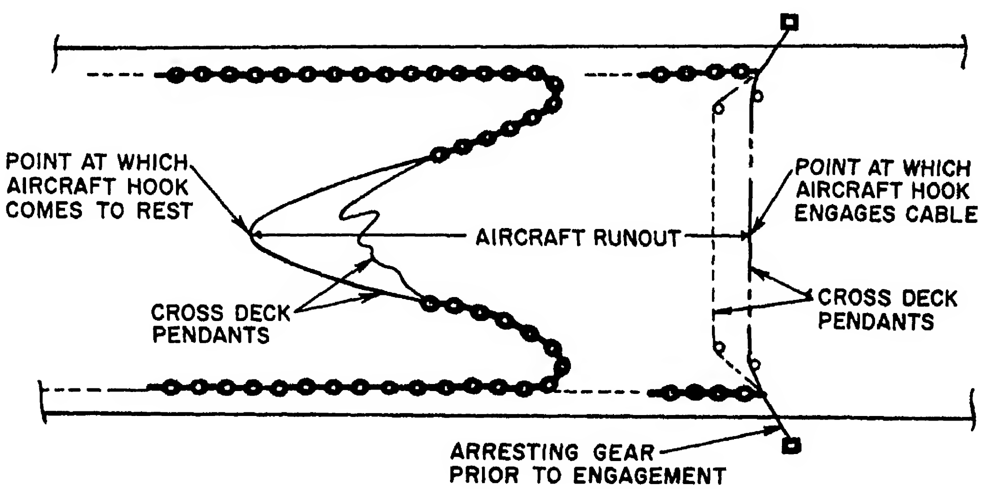

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Figure 8-17.—Operation of chain arresting gear.

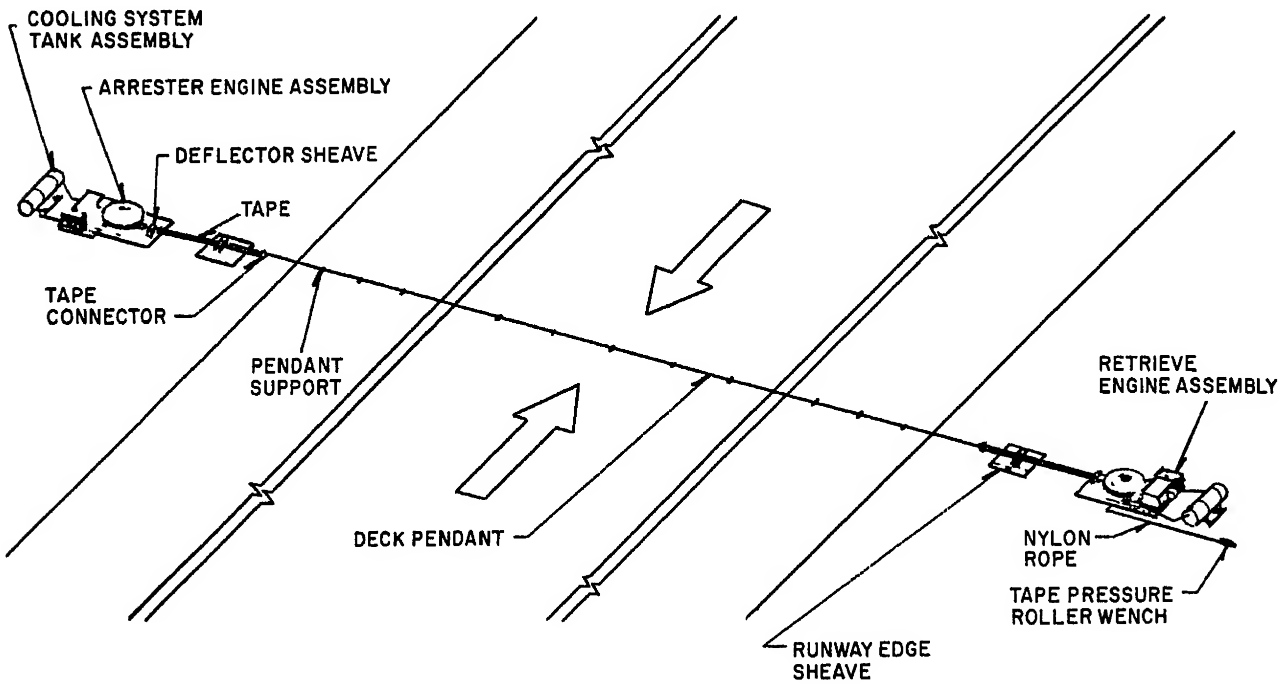

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Figure 8-18.—E-28 emergency arresting gear.

cooling tank in which the large exposed surface serves as a heat exchanger, dissipating excess heat to the outside air. The retrieve assembly is a gasoline engine-driven assembly with an electrical starting system and is operated from a control panel on the assembly base. The retrieve assembly rewinds the tape and pre-tensions the pendant after each arrest. At some locations, "trip lights" are installed to indicate that the A-Gear has been triggered and is unusable for arrestment.

EXERCISE

8-23. In what Manual would an AC find the station's Crash and Rescue Bill?

8-24. What mobile unit contains air traffic control associated equipment in addition to radios?

8-25. If severe weather conditions are forecasted, when should ATC facilities shift to auxiliary power?

8-26. Which crash alarm system may operate through the regular telephone switchboard?

8-27. The "crash networks" are a part of which system?

8-28. What are the (a) primary and (b) secondary networks referred to as?

8-29. List the six activities which are normally a part of the Primary Crash Alarm Intercommunications System.

8-30. Refer to figure 8-16. In using this grid map, to what areas would you direct a crash truck to a brush fire located between the approach ends of runways 32 and 27?

8-31. Which arresting system(s) use(s) weight as the energy absorber?

8-32. Which arresting system(s) use(s) hydraulic system as the energy absorber?

CHAPTER 9

AIR TRAFFIC CONTROL COMMUNICATIONS

Communications systems are the backbone of all Air Traffic Control facilities. Consider the vital link supplied by communications between controllers and air traffic. Without such communications, the controller is severely limited to approval or disapproval of anticipated air traffic movements and then only when visual contact exists, such as with the traffic control light as illustrated in chapter 10 of this training manual. It stands to reason that such an important tool deserves considerable attention from the controller. Existing communications equipment at naval ATC facilities is relatively simple to operate; however, correct application of the simple or basic procedures is a prerequisite to reliable communications when engaged in air traffic control. Our discussion in this chapter is intended to provide you with the fundamental knowledge necessary for the correct use of interphone and radiophone systems.

INTERPHONE SYSTEMS

Learning Objective: **Select those ATC facilities connected by interphone circuits, and state the priorities and the correct procedures used over these circuits.**

Interphone-systems (telephones) are used extensively in air traffic control as a means of instantaneous contact with related agencies. They are used to coordinate information regarding the movement of operational aircraft or aircraft about to become operational within the air traffic control system. Interphone systems handle the great volume of messages resulting from your behind-the-scene coordination procedures with other agencies. The systems must provide full-time, high-priority, direct contact for coordinating, transferring of control, relaying clearances, alerting search and rescue when necessary, or simply for relaying a position report from an aircraft. While the air traffic control communications system is a large and complex system, we discuss the system as it relates to interphones in terminal control facilities. Since systems vary from one overseas theater to another, we have further limited our discussion to those types used within the United States. We begin our discussion with the types of communication circuits that are on the facility interphone system.

COMMUNICATIONS CIRCUITS

The communications circuits on a facility's interphone system are divided into two categories: local lines and long lines. Local lines, or intercom circuits, and long lines are located side by side on the control panel of a facility's interphone equipment. The purpose of each type of circuit is to effect coordination among different control facilities and other interested agencies. Each circuit is vital to the overall functions of the facility. First, let us discuss the local lines.

Local Lines

Local lines are used to connect local airport facilities such as the weather station, tower, Ground Controlled Approach (GCA), Radar Air Traffic Control Facility (RATCF), base operations and other interested agencies within the airport's immediate area. These lines are in addition

to the emergency "crash phone" circuit which we discussed in Chapter 8. Examples of information coordinated over local lines are weather reports, local traffic coordination advisories, and flight plan data. You should know all of the agencies that are connected on your facility's local communications circuits.

Long Lines

Facilities such as air route traffic control centers (ARTCCs) and other agencies located outside the airport's immediate area are connected by long lines of your facility's interphone system. The long-line communications circuit that you are primarily concerned with in the United States is Service F. This circuit is maintained by the FAA and is used to relay aircraft movement and control messages. Service F is the primary communications circuit that links different ARTCCs to each other. Other agencies that are directly concerned with or interested in air traffic control are connected to the appropriate ARTCCs by Service F.

MESSAGE AND TRANSMISSION PRIORITIES

The ATC communications system goes into action as soon as the pilot files his flight plan. Many communications (messages) are normally conveyed from the time a flight originates until it reaches its destination. Only by establishing priorities for these messages can they be conveyed in the rapid manner demanded by air traffic control services. The two major categories of messages are emergency messages and control and movement messages.

Emergency Messages

Information concerning accidents, suspected accidents, and situations directly endangering life or property are considered to be of an emergency nature. Messages relative to accidents retain this priority only until after essential information has been transmitted to all agencies concerned. After the emergency period has passed, the messages are given a lower priority.

Movement and Control Messages

The vast majority of messages transmitted from one air traffic control service to another fall into the categories of movement and control messages. The following are some of the various messages that are included in these categories:

1. Air traffic control clearances and advisories.
2. Transfer-of-control messages.
3. Arrival reports, departure reports, and progress reports.
4. Flight plans.

Although movement and control messages are closely related, there is a distinct difference between them. Control messages are addressed to or originated by a facility exercising air traffic control authority and are required to effect proper control or coordination of air traffic. Examples of control messages are air traffic clearances and transfer-of-control messages. Messages that concern the actual movements or locations of aircraft but are not essential to the control of air traffic are referred to as movement messages. Examples of movement messages are flight plans and progress reports.

Priorities of Transmission

Air traffic control depends upon the exchange of pertinent information at a rapid pace. Therefore, it is necessary that certain priorities be established for transmittal of the information. Various factors have to be considered when determining what type of message has priority over another type. Some of the factors that you must take into consideration are (1) the types of flight plans (IFR or VFR) that the aircraft have filed; (2) the types of aircraft involved; and (3) the type of service you are providing in your communications procedures. In all cases, you are expected to use your best judgment in determining the priority to be applied. Emergency messages, of course, must be given first priority. Air traffic control messages rank second in priority to emergency messages. Miscellaneous messages, such as scheduled weather broadcasts, rank lower in priority.

When possible, your transmissions on communications systems should be given priority in the order presented below:

1. First priority—Emergency messages including essential information on aircraft accidents or suspected accidents. After an actual emergency has passed, a lower priority should be given messages relating to that accident.

2. Second priority—Clearances and control instructions.

3. Third priority—Movement and control messages using the following order of preference when possible:

   a. Progress reports.
   b. Departure or arrival reports.
   c. Flight plans.

4. Fourth Priority—Movement messages on VFR aircraft.

INTERPHONE PROCEDURE

The equipment used with interphone systems varies according to local requirements; i.e., loudspeaker, handset, headset, manual signaling by use of pushbutton, key, or dial, etc. Generally, naval facilities have a loudspeaker at the necessary control positions which must be monitored continuously since they are called by voice. To call the center or flight service (tie-in FSS), there is usually a pushbutton or dial to engage which activates a buzzer or light at the facility called. There may be several stations on one circuit, all of which may be called by voice except the center or flight service. Each station on the line has a transmit and receive capability. Voice recorders may be installed to monitor and record the systems. These recorders are discussed later in this chapter.

Telephone conversations must be brief and should be spoken at a uniform rate. Every effort must be made to enunciate clearly and distinctly, paying special attention to numerals. Use of such expressions as I guess and I think are undesirable since they are vague and indecisive. When doubt exists concerning the accuracy of a received message, the complete message or the essential parts should be repeated.

All personnel using interphone circuits should use two-letter operating initials for identification purposes. The first and last letters of your last name may be used for your operating initials. Any two letters, however, may be used to avoid confusion. Letters having similar sounds, such as B, D, C, and Z, as well as other combinations difficult to distinguish, should be avoided because they are frequently misunderstood on communications circuits. In overseas areas this is especially important, since different nationalities have varying degrees of difficulty with certain letters of the alphabet. A message is terminated by stating the operating initials of the speaker. The person receiving the message acknowledges complete receipt by stating his or her operating initials.

Voice calls are begun with the identification of the facility desired, then the identification of the facility calling. For example, MEMPHIS CENTER; NAVY MEMPHIS TOWER. Use the words EMERGENCY or CONTROL to interrupt communications in progress which have a lower priority. Normal phraseology is BREAK FOR CONTROL or BREAK FOR EMERGENCY. Other informative terms such as CLEARANCE, ARRIVAL, or DEPARTURE used as part of the initial "call-up" serves to alert the called facility to the type of message and assists the receiving controller in establishing his priority of work.

The times of arrival and departure of all aircraft for which flight plans or clearances have been received are reported promptly to the center or other appropriate agency. Arriving aircraft are reported as arrived when it is apparent that the landing is completed. Departing aircraft are reported as departed when the wheels leave the ground. Except in the transmission of emergency messages, continuous calling should be tempered with good judgment. It is well to remember that the personnel of the facility you are calling are often engaged in duties that may cause a delay in their answering you.

Standard phraseology must be used on the interphone systems. Messages are terminated with operating initials (locally assigned all ACs). The following are examples of interphone operation:

1. Tower ...... (Signals the center manually).

   Center ...... OAKLAND CENTER.

Tower . . . . . . ALAMEDA TOWER. REQUEST CLEARANCE NAVY SIX ONE EIGHT THREE FOUR.

Center . . . . . . ATC CLEARS NAVY SIX etc., ... MB (operating initials).

Tower . . . . . . BR (operating initials).

2. Center . . . . . . BRUNSWICK APPROACH, BOSTON CENTER, ESTIMATE.

Approach Control . . . . . BRUNSWICK APPROACH, GO AHEAD.

Center . . . . . . NAVY ONE TWO ONE SIX ONE, ESTIMATING etc., ... RW.

Approach Control . . . . . ST.

3. FSS . . . . . . WHITING OPERATIONS, NORFOLK RADIO, FLIGHT PLAN.

Operations . . . . . . WHITING OPERATIONS, GO AHEAD.

FSS . . . . . . NAVY SIX ONE TWO ONE TWO, FLIGHT OF THREE etc., ... WW.

Operations . . . . . . AZ.

4. Operations . . . . . . (Signals flight service manually).

FSS . . . . . . NORFOLK RADIO.

Operations . . . . . . NORFOLK OPERATIONS, ARRIVAL.

FSS . . . . . . GO AHEAD.

Operations . . . . . . (arrival message) CB.

FSS . . . . . . BC.

Clear enunciation is necessary at all times. Words should be spoken directly into the interphone instrument in a moderate tone of voice. The transmitting operator should not speak faster than the receiving operator can accurately copy. Spelling is not necessary unless a word is peculiar or seldom used. When spelling is necessary, use the phonetic alphabet discussed later in this chapter.

EXERCISE

9-1. Circle those facilities interconnected by local communications circuits.

GCA	ARTCC
Tower	Base Operations
RATCF	Weather Station

9-2. Over which long-line communications circuit are most aircraft movement and control messages passed?

9-3. Starting with the highest priority and ending with the lowest, arrange these message classifications into a list showing their respective priorities of communication. (Place correct number to side to indicate priority.)

Control messages

VFR traffic movement messages

Emergency messages

Movement messages on IFR traffic

9-4. Assume you have the following messages to communicate. One is a progress report on an IFR aircraft, another is an arrival report on an IFR aircraft, and the third is an amended clearance. Which should you deliver first, second, and third?

9-5. Assume you are working at the Navy Pensacola tower and you have an arrival message for Jacksonville Center. Write out examples of the correct procedure to use, using a voice call method.

9-6. What is missing from this interphone message?

"INDIANAPOLIS CENTER, GRISSOM TOWER, DEPARTURE."

"INDIANAPOLIS CENTER, GO AHEAD."

"BRAVO OSCAR PAPA TWO-ONE DEPARTED AT ONE TWO THREE ONE."

COMMUNICATIONS—GENERAL

Learning Objective: **Identify those general communication procedures and rules common to all air traffic control communications.**

RECEIVER CHECK

It is generally accepted practice to check all receivers at least once during each watch to be sure they are operating. Logically the oncoming watch will do this upon relieving the offgoing watch to determine the usability of the equipment. This may be accomplished by making short transmissions on each assigned frequency at one operating position with all receivers OFF at that position but ON at another position to monitor the check transmission. In actuality, both the transmitters and receivers are being checked by this method since no reception of the check transmission on a particular frequency could indicate a malfunction of either the transmitter or receiver. In the event a malfunction is indicated, controllers should notify the technicians who make further checks and repairs where necessary.

VOLUME ADJUSTMENT

NOTE: The Phone Level, Speaker Level, Mic Level controls, and VU meter referred to in this section are illustrated in chapter 10 of this training manual.

Volume adjustment is an individual operation in that each controller has his own desired level of volume. The basic requirement to consider, however, is that volume is not reduced to the extent that transmissions from aircraft within your area of responsibility might not be heard. Conditions affecting volume adjustment vary also. If a controller is monitoring only one frequency and is using a headset, then volume adjustment consists only of adjusting the Phone Level control for a comfortable listening level in the headphone. If a speaker is used, then the Speaker Level control is adjusted for a reasonable listening level but not louder than absolutely necessary, so as not to disturb other controllers at different operating positions. In the case of overhead speakers in the tower, the Speaker Level control is usually physically located in the equipment room and once the levels are set at a comfortable level, they are left in that position. However, there are times when a controller wants more volume, in which case someone has to go to the equipment room and make the adjustment.

Along with volume control, the Mic Level control should be set for proper modulation of the transmitters. To accomplish this, set all radiophone switches in the OFF position, depress the Mic switch, and speak into the microphone in a normal conversational manner. Vary the Mic Level control until the majority of the peak swings on the VU meter needle pass just above the zero level on the meter. This will properly modulate the transmitters and set the level for the interphone circuits.

FREQUENCY MONITORING

Radio frequencies are assigned to naval facilities by appropriate military authority, each for a particular function. Monitoring procedure differs between facilities; however, the normal

procedure at most continuously manned facilities is to monitor all tower and approach control frequencies on a continuous basis. At certain operating positions, such as approach control where the operator normally uses a headset, the receivers may be switched to a speaker and the volume increased during periods of light or no traffic.

UNAUTHORIZED TRANSMISSIONS

Each watch supervisor/section leader is directly responsible for all communications originating from their facility, but you must share in their responsibilities by ensuring that you do not violate the procedures and transmit any of the following categories of improper messages:

1. Obscene or profane language
2. False or deceptive communications
3. A facility identification not authorized or assigned
4. Malicious or interfering communications
5. Superfluous remarks including those of a personal nature
6. Any classified information.

AUTHORIZED TRANSMISSIONS

In addition to normal ATC transmissions, occasions may arise when messages by a third party, such as the squadron safety officer, pertaining to safety of aircraft operation or preservation of life or property, are necessary. Such messages are authorized for transmission on ATC communications channels. You may be asked to relay these messages, or the individuals concerned with the emergency may be given access to facilities to personally issue such messages. However, they SHALL NOT issue control instructions and you must be able to interrupt their transmission in the event that you must issue control instructions.

You may also relay operational or tactical instructions over ATC communications channels; however, do not agree to handle such messages on a regular basis. Always give the source of any such messages that you relay.

Official FAA messages are also authorized for transmission over ATC communications channels. The FAA Administrator and Deputy Administrator sometimes use code phrases to identify themselves in air-to-ground communications. Their codes are SAFE AIR ONE and SAFE AIR TWO, respectively.

SAFETY OF FLIGHT CONSIDERATIONS

The final approach, touch down, landing roll, takeoff, and initial climb to the first turn away from the airfield are considered to be the most critical phases of flight—phases requiring the full attention of the pilot. Except during radar approaches or departures, you should refrain from transmitting to the aircraft during these phases of the operation unless conditions affecting safety of flight are observed or are known to exist. Safety of flight considerations, including airfield conditions, shall be transmitted at any time observed by you, or made known to you.

COMMUNICATIONS SECURITY

Needless to say, any time you use a radio transmitter to make a transmission, it is "in the clear," so to speak. This refers to the fact that anyone with the equipment and the desire to listen to your conversation can do so with relative ease. Therefore, general radio communications must head the list as the most insecure form of communications. There is simply no way of knowing who is listening to your conversation. Uncontrolled reception is the official way of expressing this fact. We feel sure that you are not going to knowingly transmit classified information over the air. However, from time to time you will have access to bits of information which could be useful and of intelligence value. Therefore, be cautious about "bit" information and never try "talking around" a subject. Stick to air traffic control and refer requests for information outside of air traffic control to your watch supervisor.

Radio is the most insecure means of communication, but close on its trail is the telephone. When we speak of the telephone, we have a tendency to limit our thoughts to the instrument itself and, because of the seemingly private nature of telephone conversations, we gain a false sense of security. If we picture the system in its

entirety—wires, operators, and radio relay stations—then it is not difficult to understand how easy it is for an uninvited listener to be on the line. Basically, the same rules which apply to radio transmissions apply to telephone conversations. You should always assume that someone is monitoring your telephone calls; then the likelihood of classified information slipping into the conversation will be reduced.

The security of ATC communications is not normally a major factor during periods of peacetime, particularly within the U.S.; however, during wartime, where the Navy is operating carriers in close proximity to land areas, this subject takes on a different perspective.

Communications security (COMSEC) is the protection resulting from the application of measures designed to deny the enemy, or other unauthorized persons, information of value which might be derived from a study of communication materials and information. An additional objective is to mislead unauthorized persons in their interpretation of the results of such a study.

Defenses Against Interception

Transmission security measures are based upon the following two assumptions:

1. Electromagnetic transmissions can be intercepted and recorded by the enemy.
2. Silence is the only positive protective measure against enemy interceptions and direction finding activity.

Based upon these assumptions, the following defensive measures have been developed and should be used whenever possible or appropriate:

1. Use the least amount of transmitter power consistent with reliable communications.
2. Eliminate unnecessary and unauthorized transmissions.
3. Reduce transmission time to a minimum.
4. Ensure transmitting and receiving equipment is adjusted accurately.
5. Maintain strict circuit discipline.

Factors to consider when attempting to limit the interception or jamming of radio transmissions include the nature of the transmission path, propagation conditions (discussed in chapter 6), frequencies employed, and equipment used.

Propagation conditions affect the range of transmissions; line-of-sight distances in the Very High Frequency (VHF) band and higher ranges are exceeded because of abnormal and unpredictable ionosphere and meteorological conditions.

Electronic Emission Control (EMCON)

As has been pointed out, no radio transmission, whatever its nature and the area in which it is made, can be regarded as being completely safe from interception.

Electronic Emission Control (EMCON) procedures have been established onboard aircraft carriers and other surface ships to minimize the possibility of radio transmissions being intercepted by the enemy.

These procedures provide a control of all electromagnetic radiations, including radar as well as communications equipment. During the imposition of EMCON, no electronic emitting device will be operated unless it has been determined to be essential to the mission.

Varying degrees of EMCON silence exist; these are based upon the following factors:

1. Type of mission
2. Tactical situation
3. Frequency band being utilized
4. Propagation characteristics of the equipment employed.

The responsibility for determining the requirements necessary for the implementation of EMCON silence rests with the appropriate Fleet Commander. Since the actual conditions under which emission control would be implemented are classified, no attempt will be made here to list the varying degrees of EMCON silence.

If you are assigned duties in a Carrier Air Traffic Control Center (CATCC) (discussed in chapter 14), you will receive detailed instructions concerning this vital area of communications security.

SCATANA

Federal Air Regulation 99.7 (special security instructions) is quoted in part: "....comply with special security instructions issued by the Administrator in the interest of national security and that are consistent with appropriate agreements between the FAA and Department of Defense."

The special security instructions referred to in the above paragraph are the plan for the Security Control of Air Traffic and Air Navigation Aids (short title: SCATANA). This plan is distributed in the Navy as OPNAV Instruction 3722.30 (Series). This plan defines the responsibilities of the Administrator and the appropriate military authorities for the security control of civil and military air traffic and Federal air navigation aids. It defines the responsibility of the Federal Communications Commission (FCC) for the security control of non-Federal civil air navigation aids. It describes the situations which concern national security, and the necessary action to be taken in the event of SCATANA alert. It also provides for testing the plan at least once every 60 days but not more than 12 times a year.

During SCATANA tests, all actions are simulated to achieve the following objectives:

1. Aircraft need not be grounded or diverted.
2. Air navigation aids should not be shut down.
3. Test messages are not transmitted over air/ground/air frequencies.
4. Interruption of radio communications is not necessary.

Figure 9-1 illustrates the SCATANA Test Report (FAA Form 2372-1) which is completed upon termination of the SCATANA test and forwarded to the appropriate Air Route Traffic Control Center (ARTCC).

You should study OPNAV Instruction 3722.30 (Series) as all control tower personnel will

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION **SCATANA TEST REPORT**	TEST DATE	FACILITY NAME

	ACTION	ACTION TIME (GMT)
1	SCATANA Test Message received from –	Z
2	Broadcast simulated	Z
3	Notification completed (FAA Form 7610–1, item 1A)	Z
4	Area simulated clear of known aircraft	Z
	ARTCC at notified	Z
5	Simulated shutdown of air NAVAIDS listed in item 2A, FAA Form 7610–1	Z
6	"Terminate SCATANA/modify emergency SCAT rules" message received	Z
	Simulated return of air NAVAIDS to operation	Z
	Simulated broadcast of "termination/modification" message	Z

OFFICES NOT ALERTED *(Listed in item 1A on FAA Form 7610–1)*	SIGNATURE OF PERSON REPORTING
FAA Form 7610–3 (9–70)	*Form Approved. OMB No. 04–R0068*

Figure 9-1.—SCATANA Test Report.

become involved in an actual implementation of the plan or the frequent test procedures.

EMERGENCY COMMUNICATIONS

Because of the infinite variety of possible situations, specific procedures cannot always be prescribed for every situation which might be considered an emergency. As a rule of thumb, an emergency includes any situation which places an aircraft in danger; i.e., uncertainty, alert, being lost, or in distress. Emergency communications would be any communications associated with these situations as described.

All military towers and most civil towers guard the emergency frequencies 121.5 MHz and 243.0 MHz. The prowords established for use to indicate the severity of an emergency situation in voice communication are MAYDAY, to indicate that the aircraft is threatened by serious and imminent danger and immediate assistance is required; and PAN, to indicate that the aircraft is in a situation which requires urgent action but is not in actual distress.

You may expect to receive the following information from pilots of aircraft in an emergency condition:

1. PAN or MAYDAY three times and aircraft call sign three times
2. Type of aircraft
3. Actual or estimated position with the time
4. Heading
5. Indicated airspeed
6. Altitude/FL
7. Fuel remaining (in hours and minutes)
8. Nature of emergency
9. Pilot's intentions
10. Assistance desired
11. Two 10-second dashes with the mike button for DF purposes.

The pilot will accept "communications control" of one particular ground station, and all other stations must remain silent so as not to interfere.

CIRVIS MESSAGES

The contraction CIRVIS is derived from the title of a document published by the Joint Chiefs of Staff, Joint Communication Electronics Board. This publication, JANAP (Joint Army, Navy, Air Force Publication) 146E is entitled "Canadian-United States Communications Instructions for Reporting Vital Intelligence Sightings." FAA facilities become involved with CIRVIS messages since they contact aircraft, both civil and military, by radio.

The procedures used by aircraft to call ground stations and report CIRVIS information should be similar to those used when sending position reports, except that the call should be preceded by the word CIRVIS (pronounced SURVEES) spoken three times to clear the frequencies of all other communications except DISTRESS or URGENCY. Should this procedure fail to clear the frequencies, the International Urgency Signal XXX transmitted three times on telegraph transmissions or the word PAN spoken three times may be employed as an alternate signal. CIRVIS reports are transmitted in plain language and as soon as possible (FLASH precedence is authorized) to any U.S. or Canadian military or civil air-ground communications facility.

There are three types of CIRVIS messages which controllers may be called upon to handle, as follows:

1. CIRVIS Report. Initial sighting report.

2. Additional CIRVIS Reports. Additional reports should be made if more information becomes available concerning a previously sighted object. These reports should contain a reference to the original report to identify them with it.

3. Cancellation Report. Cancellation reports should be made in the event that a previously reported sighting is positively identified as friendly or that it has been erroneously reported.

EXAMPLE OF INITIAL CIRVIS REPORT:

Aircraft—CIRVIS CIRVIS CIRVIS, BERMUDA THIS NAVY TWO FIVE NINER THREE SIX, CIRVIS REPORT, OVER.

Communications facility—NAVY TWO FIVE NINER THREE SIX, THIS IS BERMUDA, GO AHEAD.

Aircraft—NAVY TWO FIVE NINER THREE SIX SIGHTED FORMATION OF SIX JET BOMBERS, CONFIGURATION IS SWEPT WING WITH EIGHT JET ENGINES, TWO HUNDRED MILES EAST OF BERMUDA ON THIRTEEN MAY AT ONE THREE FIVE ZERO ZULU, ALTITUDE THREE FIVE THOUSAND, HEADING TWO SEVEN ZERO DEGREES, NO MARKINGS OBSERVED, OVER.

Communications station—BERMUDA, ROGER OUT.

FAA stations and Navy towers must immediately pass the CIRVIS messages to the appropriate ARTCC. FAA ARTCCs forward the CIRVIS messages immediately by direct interphone to the appropriate military service, or higher headquarters, as required by JANAP 146E.

EXERCISE

9-7. When must radios be checked for proper operation?

9-8. State six examples of unauthorized transmissions.

9-9. Briefly explain what transmissions, other than normal ATC transmissions, may be made over ATC communications channels.

9-10. Which phases of flight are considered to be the most critical?

9-11. Briefly explain why routine radio and telephone voice communications is insecure.

9-12. What procedures have been established onboard ships to ensure COMSEC?

9-13. What plan defines the responsibilities of the Administrator and the appropriate military authorities for the security control of civil and military air traffic and air navigation aids?

9-14. Match a proword or phrase in column A with a meaning in column B by placing the letter of the item in column A in the space provided in column B. Use each item in column A only once or not at all.

Column A	Column B
A. COMSEC	____1. An aircraft is in a situation which requires urgent action.
B. SECURITY	
C. CIRVIS	____2. An aircraft is reporting the sighting of an unknown aircraft.
D. PAN	
E. MAYDAY	____3. An aircraft is in distress.
F. URGENCY	
G. DISTRESS	

RADIO PROCEDURES AND TECHNIQUES

Learning Objective: **State the proper procedures for, and format of, radio messages; state desirable and undesirable mannerisms when using radio communications.**

RADIO PROCEDURES

It has been proved time and time again that the procedures a controller follows when traffic

is light will be the same procedures he follows when things are busy and the chips are down. If you have a sloppy radio technique, waste time with meaningless words, and don't follow the established procedures, it is sure to show up some day—most often when you wish it hadn't. Let us review some basic procedures as established in FAA Handbook 7110.65.

Radio Message Format

Initiate radio communications with an aircraft by using the following format:

a. Initial call-up:

(1) Identification of the aircraft being called.
(2) Identification of the calling unit.
(3) The type of message to follow when it will assist the pilot.
(4) The word OVER, if required.

EXAMPLE: MARINE THREE ONE FIVE SIX EIGHT, NAS LEMOORE TOWER, ATC CLEARANCE, OVER; NAVY GOLF ALFA TWO ONE, NAS LEMOORE TOWER, OVER

b. Replying to a call-up from an aircraft:

(1) Identification of the aircraft initiating the call-up.
(2) Identification of the replying unit.
(3) The word OVER, if required.

c. Use the same format as for initial call-up and reply after communications have been established except after stating your identification, state your message or acknowledge a message received, and the word "over" if required.

EXAMPLE: "BOXER SIX ONE, WHITING GCA, IDENT, OVER."

d. Preface a clearance or instructions intended for a specific aircraft with the identification of that aircraft. You may omit, after initial call-up, the aircraft's identification when conducting the final portion of a radar approach.

Abbreviated Transmissions

You are authorized to shorten transmissions when no confusion is likely to result, as follows:

a. After communication has been established with an aircraft and the type of aircraft is known, you may use the identification prefix and the last three digits of the identification. However, do not abbreviate the identification of an air carrier, other civil aircraft having FAA authorized call sign, or a military tactical call sign.

b. Omit the facility identification after communication has been established.

c. Transmit messages immediately after call-up (without waiting for the aircraft to reply) when they are short and receipt is generally assured.

d. Omit the word OVER if the message obviously requires a reply.

In the following example, the words which may be omitted are enclosed within parentheses:

Aircraft—(MIRAMAR TOWER) NAVY (SEVEN FIVE) ONE THREE ONE, FOUR MILES SOUTH (AT) TWO THOUSAND, LANDING MIRAMAR, (OVER).

Tower—NAVY (SEVEN FIVE) ONE THREE ONE ROGER, RUNWAY TWO FOUR, WIND TWO SIX ZERO AT ONE FIVE, (OVER).

Aircraft—NAVY (SEVEN FIVE) ONE THREE ONE, (ROGER) (OUT).

Transfer of Communications

Transfer radio communications by specifying to the aircraft the following:

(1) Location name of the facility
(2) Frequency to use
(3) The time, fix, altitude, or specified condition to contact the receiving facility.

NOTE: You may omit item three if the change is to be made on receipt.

You may omit the location name when transferring communications to another controller within your facility, except when instructing the aircraft to change to a frequency for final approach guidance; then the location name must be included. Also, you may omit repeating a departure control frequency if previously given as part of the clearance. When directing a pilot to change to ground control after landing, the numbers preceding the decimal point in the

frequency may be omitted if you are sure the pilot will understand. When directing a pilot to the local tower frequency after landing, either the entire frequency or the numbers preceding the decimal point may be omitted—again if you are sure the pilot will understand. However, do not use this procedure with general aviation aircraft which are not locally based or at locations using more than one local control frequency. Finally, you may omit the frequency of a Flight Service Station in the transfer process.

TRANSMISSION TECHNIQUE

In a trade or profession, you are judged by the skill with which you use tools. In air traffic control, you are judged by your radio transmission technique as well as on the quality of your control instructions. Successful air traffic control depends on a complete understanding between you and the pilot. Such understanding is based on clear and concise words and phrases, the meanings of which are standardized, and as transmitted are completely understandable on the first transmission.

Standard phraseology is carefully designed to avoid misinterpretation, to be understood at high noise levels, and to convey the same meaning to all. The correct use of established phraseology is a major part of your job.

Manner of delivery is also a vital factor. The tone should be pleasant, the words clear and easily understood. Emphasize words, digits, or letters for clarification. Words such as "I think" and "I suppose" have no value in air traffic control. You must be firm and specific with your control or pilots quickly lose confidence in your ability to control the situation. Also, the use of attention demanding words such as "Immediately" and "Caution" are to be restricted to only those occasions requiring their use.

Some controllers have developed a habit of increasing their rate of speech as the aircraft progresses closer to the runway or touchdown point on final approach. If you have developed the habit or might be starting to, we suggest you start now and practice a uniform rate of speech throughout the approach sequence.

The language of air traffic control is not technically difficult, nor does it contain strange-sounding words or names. It consists of words and phrases which have a specific meaning to controllers and pilots. These words are used without variation, whenever possible, in every aspect of air traffic control. A phrase that means the same to all users is most effective. In air traffic control there is no room for adornment of the message by the speaker's personality nor for varied interpretations by the listener.

The phonetic alphabet is used to help prevent confusion during periods when communication is difficult. For the best results when studying the phonetic alphabet which follows, READ THE WORDS ALOUD.

INTERNATIONAL PHONETIC ALPHABET

LETTER	RECOGNIZED WORD	PRONUNCIATION
A	ALFA	AL-FAH
B	BRAVO	BRAH-VOH
C	CHARLIE	CHAR-LEE or SHAR-LEE
D	DELTA	DELL-TAH
E	ECHO	ECK-OH
F	FOXTROT	FOKS-TROT
G	GOLF	GOLF
H	HOTEL	HOH-TELL
I	INDIA	IN-DEE-AH
J	JULIETT	JEW-LEE-ETT
K	KILO	KEY-LOH
L	LIMA	LEE-MAH
M	MIKE	MIKE
N	NOVEMBER	NO-VEM-BER
O	OSCAR	OSS-CAH
P	PAPA	PAH-PAH
Q	QUEBEC	KEH-BECK
R	ROMEO	ROW-ME-OH
S	SIERRA	SEE-AIR-RAH
T	TANGO	TANG-GO
U	UNIFORM	YOU-NEE-FORM or OO-NEE-FORM
V	VICTOR	VIK-TAH
W	WHISKEY	WISS-KEY
X	XRAY	ECKS-RAY
Y	YANKEE	YANG-KEY
Z	ZULU	ZOO-LOO

EXERCISE

9-15. List the order of radio format for transferring communications from one facility to another (do not list exceptions).

9-16. When replying to a call-up, list the proper sequence of procedure.

9-17. Write a simple example showing the proper sequence of format assuming your facility is Whiting Tower and you are calling Skip 21.

9-18. What is the most desirable characteristic of a transmitted control instruction?

9-19. What purpose does the correct use of established phraseology have in radio communications?

9-20. Why would the words "I think" or "I suppose" not be desirable for a controller to use?

9-21. Briefly explain an undesirable mannerism some radar controllers develop.

9-22. Would the word "IMMEDIATELY" be desirable or undesirable in communicating instructions? Explain.

PHRASEOLOGY

Learning Objective: **Recognize proper radio transmission procedures, including phraseology.**

Your use of standard phraseology is necessary for efficient utilization of communications frequencies. Controllers through acquired experience in using standard phraseology are able to make transmissions as brief as possible, yet completely understandable. Proficiency may be developed to the extent that in the exchange of communications between controller and pilot the intent of the message is understood even before the verbal transmission is complete. In other words, proper phraseology is second nature to a proficient controller.

Radio Ground Checks

To give a radio check a better description than you actually receive could jeopardize a pilot's life by putting him in instrument flying conditions with a poor radio, or cluttering the already crowded airways with an aircraft that has an inoperative radio.

Give an accurate response to a request for a radio check by using one of the following examples.

1. LOUD AND CLEAR
2. LOUD AND GARBLED
3. WEAK BUT CLEAR
4. WEAK AND GARBLED
5. UNREADABLE

Avoid depressing the mike button until absolutely ready to talk. Do not tie up a frequency with excessive test signals and radio checks. Normally, radio checks are completed prior to the start of daily flight operations, thus causing little interference with the tower routine during peak periods of traffic.

Identification of Ground Facilities

You must know how ground facilities such as towers, centers, approach control, and communications stations are identified during radiotelephone communications. You also must

know how to identify all types of aircraft—even those of foreign registry. You cannot communicate with these aircraft properly if you are not completely familiar with how to make radio contacts through use of standard phraseologies.

Airport traffic control towers are identified during radiotelephone communications as follows:

State the name of the facility, followed by the word TOWER. Where military and civil airports are located in the same general area and have similar names, state the name of the military service, followed by the name of the military facility and the word TOWER.

EXAMPLES: MEMPHIS TOWER; NAVY MEMPHIS TOWER.

Air Route Traffic Control Centers (ARTCCs) are identified by the location name followed by the word CENTER.

EXAMPLE: KANSAS CITY CENTER.

Approach control facilities, including Army radar approach control facilities (ARACs), and radar approach control facilities associated with the USAF (RAPCONs) are identified by the name of the facility, followed by the word APPROACH. Where military and civil facilities are located in the same general area and have similar names, state the name of the military service, followed by the name of the military facility, and the word APPROACH.

EXAMPLES: DENVER APPROACH; NAVY JACKSONVILLE APPROACH.

Functions within a terminal facility are identified by the name of the facility, followed by the name of the function.

EXAMPLES: OCEANA DEPARTURE; MERIDIAN GROUND.

Radar facilities having air surveillance radar (ASR) and/or precision approach radar (PAR) but not providing approach control service are identified by the name of the facility followed by the letters "G-C-A."

EXAMPLE: ALAMEDA G-C-A.

Air traffic communications stations are identified during radiotelephone communications in the following manner:

Navy communications stations; by the word NAVY, followed by the name of the station and the word RADIO.

EXAMPLE: NAVY NORFOLK RADIO.

Air Force communications stations; by the name of the station followed by the word AIRWAYS.

EXAMPLE: BROOKLEY AIRWAYS.

FAA flight service stations (FSS) by the name of the station followed by the word RADIO.

EXAMPLE· LEXINGTON RADIO.

Aircraft Identification

Military fixed-wing aircraft are identified by one of the following:

1. The service name followed by the last five digits of the serial number.

EXAMPLE: NAVY FIVE SIX ONE TWO THREE.

2. Military helicopters are identified by the service name, the word COPTER, and the last five digits of the serial number.

EXAMPLE: NAVY COPTER FIVE SIX ONE TWO SIX.

3. Military tactical and training.

a. U. S. Air Force, Air National Guard, Military District of Washington priority aircraft, and USAF civil disturbance aircraft—Pronounceable words of 3, 4, 5, or 6 letters followed by a 4-, 3-, 2-, or 1-digit number.

EXAMPLES: PAUL TWO ZERO; GAYDOG FOUR; PAT ONE FIVE SEVEN.

b. Navy or Marine fleet and training command aircraft—The service name and 2 letters or a digit and a letter (use letter phonetic equivalents) followed by 2 or 3 digits.

EXAMPLE. NAVY GOLF ALPHA TWO ONE.

c. North American Air Defenses (NORAD) interceptors—An assigned double letter 2-digit flight number.

EXAMPLE. ALPHA KILO ONE FIVE.

d. Foreign military—Except Canada, the name of the country and the military service followed by the separate digits or letters of the registration or call sign. Canadian Armed Force aircraft shall be identified by the word CANFORCE followed by separate digits of the serial number, except that the Transport Command of the Canadian Armed Force shall be identified by the words CANADIAN MILITARY followed by the separate digits of the serial number.

EXAMPLES: CANFORCE FIVE SIX TWO ONE; BRAZILIAN AIR FORCE FIVE ONE SIX EIGHT ONE.

4. Presidential or Vice Presidential aircraft are identified as follows:

a. When the President or the Vice President is aboard a military aircraft, state the name of the military service followed by the word ONE for the President or the word TWO for the Vice President.

b. When the President or the Vice President is aboard a civil aircraft, state the words EXECUTIVE ONE for the President or EXECUTIVE TWO for the Vice President.

c. When a member of the President's family is aboard any aircraft, and the U.S. Secret Service or the White House Staff determines it is necessary, state the words EXECUTIVE ONE FOXTROT.

Civil aircraft are identified by the aircraft type, model name, or manufacturer's name (if none of these are known, use the word NOVEMBER or the letter N), followed by the digits and letters of the registration number.

EXAMPLES: APACHE ONE FOUR TWO PAPA; DOUGLAS THREE ZERO ONE ROMEO; NOVEMBER THREE SEVEN ONE FIVE.

Air carrier and other civil aircraft having FAA authorized call signs are identified by the call sign followed by the flight number in group form.

EXAMPLES: AMERICAN FIVE TWENTY ONE; COMMUTER SIX ELEVEN; GENERAL MOTORS THIRTY SEVEN.

Air taxi and commercial operators which do not have a FAA authorized call sign, are identified by the prefix TANGO on initial contact followed by the registration number. The prefix may be dropped in subsequent communications.

EXAMPLE: TANGO MOONEY FIVE FIVE FIVE TWO QUEBEC.

Aircraft involved in airborne ambulance or special military operations are identified as follows:

1. Civilian airborne ambulance—The word LIFEGUARD followed by the type, digits, and letters of the registration number.

EXAMPLE: LIFEGUARD CESSNA TWO SIX FOUR SIX.

2. Special military operations—One of the following words or phrases followed by the last 5 digits of the serial number:

a. Air evacuation flights—AIR EVAC, MARINE AIR EVAC, or NAVY AIR EVAC.

EXAMPLE: AIR EVAC ONE SEVEN SIX FIVE TWO.

b. Rescue flights—(Service name) followed by RESCUE.

EXAMPLE: NAVY RESCUE ONE SEVEN SIX FIVE TWO.

c. Military Airlift Command—MAC.

EXAMPLE: MAC ONE SEVEN SIX FIVE TWO.

d. Special Air Mission—SAM.

EXAMPLE: SAM ONE SEVEN SIX FIVE TWO.

e. USAF Contract Aircraft—LOGAIR.

EXAMPLE: LOGAIR ONE SEVEN SIX FIVE TWO

3. Other special flights are identified as shown below:

a. Department of Energy flights—The letters RAC (use phonetic alphabet) followed by the last 4 separate digits of the registration number.

b. Semiautomatic Flight Inspections—The code name SAFI followed by the separate digits of the field grid number of the planned flight.

c. Flight inspection of navigational aids—The call sign FLIGHT CHECK followed by the digits of registration number.

EXAMPLES: (a) ROMEO ALFA CHARLIE ONE SIX FIVE THREE; (b) SAFI FIVE TWO SEVEN; (c) FLIGHT CHECK THREE NINER SIX FIVE FOUR.

Aircraft of foreign registry are identified by one of the following:

1. Civil—The letters or digits of the aircraft registration or call sign.

EXAMPLE: C-F-R-L-G.

2. Air carrier—The abbreviated name of the operating company followed by the letters or numbers of the registration or call sign or the flight number in group form.

EXAMPLES: AIR FRANCE F-L-R-L-G; SCANDINAVIAN SIXTY ONE.

If you should encounter an unfamiliar call sign, the same identification as the pilot used in the initial callup should be used in the reply even though it may be different from those listed in the appropriate publications.

Description of Aircraft Types

When you are issuing traffic information to another aircraft, describe the aircraft as follows:

1. Military—The military designator, with numbers spoken in group form; the service and type; or the type only, if no confusion or misidentification is likely.

EXAMPLES: F—FOUR; NAVY FIGHTER; FIGHTER.

2. Air Carrier—State the manufacturer's name or model. Add the company name or other identifying features when confusion or misidentification is likely.

EXAMPLES: LOCKHEED TEN-ELEVEN; AMERICAN SEVEN-OH-SEVEN; UNITED SEVEN THIRTY-SEVEN.

Pilots of interchange aircraft are expected to inform the tower on first radio contact the name of the operating company and trip number, followed by the company name as displayed on the aircraft, and aircraft type.

EXAMPLE: PENSACOLA TOWER, AMERICAN FOUR TWENTY-ONE, A UNITED SEVEN-OH-SEVEN, OVER.

3. General aviation and air taxi—Describe these aircraft by the manufacturer's model, name, or designator and, when considered advantageous, its color.

EXAMPLES: TRI-PACER; PA TWENTY-TWO; GREEN APACHE.

NOTE: When issuing traffic information to aircraft following a heavy jet, specify the word HEAVY and the type of aircraft.

EXAMPLE· HEAVY LOCKHEED TEN-ELEVEN.

Procedure Words and Phrases

Your success in handling both routine and nonroutine traffic situations depends on your ability to reason and to be consistent in the application of good control procedures. Since it is impractical to specify words and phrases to cover every traffic situation, you must use your best judgment when nonstandard terms have to be used. In a nonroutine situation, you must limit your language to brief, easily understood English. It is important that you use terms that cannot be misinterpreted. If you plan what to say, your delivery will be smooth and brief. Your transmissions will have the sound of professionalism. Some examples of procedural words and phrases which are standard in normal air traffic control communications are shown below:

WORDS AND PHRASES	MEANING
Acknowledge	Let me know that you have received and understand this message.
Affirmative	Yes.
Correction	An error has been made in this transmission (or message indicated). The correct version is ......
Go ahead	Proceed with your message.
How do you hear me	Self-explanatory.
I say again	Self-explanatory.
Negative	No or Permission not granted or That is not correct.
Out	This conversation is ended and no response is expected.
Over	My transmission is ended and I expect a response from you.
Read back	Repeat all of this message back to me.
Roger	I have received all of your last transmission. (To acknowledge receipt; do not use for any other purpose).
Say again	Self-explanatory.
Speak slower	Self-explanatory.
Standby	I must pause for a few seconds. (If the pause is longer than a few seconds, or, if used to prevent another station from transmitting, add the ending, OUT.)
That is correct	Self-explanatory.
Verify	Confirm.
Wilco	I have received your message, understand it and will comply.
Words twice	Communication is difficult. Please say every phrase twice. (As a request.) Since communication is difficult, every phrase in this transmission will be spoken twice. (As information.)

Statement of Numbers

Statement of numbers is always of extreme importance in radiotelephone messages. The following pronunciation of the numerals has been found to be the best and most intelligible:

NUMERALS	PRONUNCIATION
1	WUN
2	TOO
3	TREE
4	FOW-ER
5	FIFE
6	SIX
7	SEV-EN
8	AIT
9	NIN-ER
0	ZERO

ALTITUDES.—State the separate digits of the thousands plus the hundreds.

EXAMPLES:

ALTITUDE	STATEMENT
500	FIVE HUNDRED
4,500	FOUR THOUSAND FIVE HUNDRED
9,000	NINER THOUSAND
10,000	ONE ZERO THOUSAND
13,000	ONE THREE THOUSAND

FLIGHT LEVELS.—State the words FLIGHT LEVEL, followed by the separate digits of the flight level.

EXAMPLES:

FLIGHT LEVELS	STATEMENT
180	Flight level one eight zero.
275	Flight level two seven five.

SERIAL NUMBERS.—State the separate digits.

EXAMPLES:

NUMBER	STATEMENT
18143	ONE EIGHT ONE FOUR THREE
26075	TWO SIX ZERO SEVEN FIVE

TIME.—State the separate digits of the hour and minutes in terms of Greenwich Mean Time (GMT) based on the 24-hour clock.

EXAMPLES:

TIME	STATEMENT
0615 GMT	ZERO SIX ONE FIVE
2230 GMT	TWO TWO THREE ZERO

NOTE: GMT is often referred to as ZULU time which is the phonetic equivalent of the designated letter suffix (Z) of the zero time zone.

Upon request, state the digits of the hours and minutes in terms of GMT, followed by local standard time based on the 24-hour clock.

EXAMPLE

TIME	STATEMENT
1430 PST (2230 GMT)	TWO TWO THREE ZERO GREENWICH, ONE FOUR THREE ZERO PACIFIC

TIME CHECKS.—State the word TIME followed by the separate digits of the hour, minutes, and nearest quarter minute.

EXAMPLE: TIME, ONE FOUR ONE FIVE AND THREE QUARTERS

ABBREVIATED TIME.—State the separate digits of the minutes only.

EXAMPLE.

TIME	STATEMENT
1415	ONE FIVE

FIELD ELEVATION.—State the words FIELD ELEVATION followed by the separate digits of the elevation.

EXAMPLES:

ELEVATION	STATEMENT
17 feet	FIELD ELEVATION ONE SEVEN
150 feet	FIELD ELEVATION ONE FIVE ZERO

ALTIMETER SETTING.—State the word ALTIMETER, followed by the separate digits of the altimeter setting.

EXAMPLE:

SETTING:	STATEMENT
30.01	ALTIMETER, THREE ZERO ZERO ONE

SURFACE WIND.—State the word WIND, followed by the indicated wind direction to the nearest 10-degree heading, the word AT, and the indicated velocity in knots.

EXAMPLE: WIND, TWO SIX ZERO AT ONE FIVE.

HEADINGS.—State the word HEADING, followed by the three digits of the number of degrees and omit the word DEGREES. Use heading 360 to indicate a north heading.

EXAMPLES:

HEADING	STATEMENT
005 degrees	HEADING ZERO ZERO FIVE
095 degrees	HEADING ZERO NINER FIVE

RADAR BEACON CODES.—State each digit of the four-digit code.

EXAMPLES:

CODE	STATEMENT
1000.	ONE ZERO ZERO ZERO
2100..	TWO ONE ZERO ZERO

RUNWAYS.—State the word RUNWAY, followed by the separate digits of the runway designation. For a parallel runway, state the word LEFT, CENTER, or RIGHT if the letter L, C, or R is included in the designation.

EXAMPLES:

DESIGNATION	STATEMENT
3	RUNWAY THREE
24L	RUNWAY TWO FOUR LEFT
7R	RUNWAY SEVEN RIGHT

FREQUENCIES.—State all the digits of the frequency, inserting the word POINT where the decimal point occurs. When the frequency is in the L/MF band, include the word KILOHERTZ.

EXAMPLES:

FREQUENCY	STATEMENT
142.74 MHz	ONE FOUR TWO POINT SEVEN FOUR
360.2 MHz	THREE SIX ZERO POINT TWO
302 kHz	THREE ZERO TWO KILOHERTZ

SPEEDS.—1. State the separate digits of the speed followed by the word KNOTS.

EXAMPLES:

SPEED	STATEMENT
250	TWO FIVE ZERO KNOTS
180	ONE EIGHT ZERO KNOTS
90	NINER ZERO KNOTS

NOTE: The word KNOTS may be omitted when using speed adjustment procedures.

2. The separate digits of the mach number preceded by the word MACH.

EXAMPLE: MACH ONE POINT FIVE.

MILES.—State the separate digits of the mileage followed by the word MILE(S).

EXAMPLES: THREE ZERO MILE ARC EAST OR NOTTINGHAM; TRAFFIC, ONE O'CLOCK, TWO FIVE MILES, NORTHBOUND, DC-EIGHT.

NOTE: The air NAVAIDs referred to in the next section are discussed in Chapter 6 of this manual.

Airways and Jet Route Description

One of the Air Traffic Controller's most important duties is correctly copying and relaying IFR clearances to IFR flights.

A careful study of the following procedures and examples will enable you to properly describe routes and NAVAIDs, using proper phraseology.

VOR/VORTAC/TACAN AIRWAYS.—State the word VICTOR followed by the number of the airway in group form. For area navigation (RNAV) routes add the word ROMEO.

EXAMPLES:

VICTOR THREE NINETEEN.
VICTOR SEVEN TEN ROMEO.

VOR/VORTAC/TACAN JET ROUTES.—State the letter J followed by the route number in group form. For RNAV routes add the word ROMEO.

EXAMPLES:

J SIXTY NINER.
J EIGHT THIRTY ROMEO.

L/MF AIRWAYS.—State the color of the airway followed by the number in group form.

EXAMPLE: BLUE EIGHTY ONE.

NAVAID Description

Describe radials, arcs, courses, and bearing of navaids as follows:

VOR/VORTAC/TACAN NAVAIDS.—State the name of the NAVAID, followed by the magnetic bearing of the radial, omitting the word DEGREE.

EXAMPLE: MEMPHIS TWO FIVE ZERO RADIAL.

ARCS ABOUT VOR-DME/VORTAC/TACAN NAVAIDS.—State the distance in miles from the NAVAID, followed by the words MILE ARC, the direction from the NAVAID in terms of the eight principal points of the compass, the word OF, and the name of the NAVAID.

EXAMPLE: TWO ZERO MILE ARC NORTHWEST OF GRANTSVILLE.

L/MF NAVAIDS.—State the name of the station, followed by the bearing of the course from the station in terms of the eight principal points of the compass, and the word COURSE.

EXAMPLE: ROSWELL NORTHEAST COURSE.

NONDIRECTIONAL BEACONS.—State the course to, or the bearing from the radio beacon, omitting the word DEGREE, followed by the words COURSE TO, or BEARING FROM, the name of the radio beacon and the words RADIO BEACON.

EXAMPLES: ZERO FOUR FIVE BEARING FROM MEMPHIS RADIO BEACON; TWO TWO FIVE COURSE TO MEMPHIS RADIO BEACON.

NAVAID Fix Description

Describe fixes determined by reference to a radial/localizer and distance from a VOR-DME/VOR-TAC/TACAN/ILS-DME as follows:

a. When a fix is not named, state the name of the NAVAID followed by the specified radial/localizer and state the distance in miles followed by the phrase MILE FIX.

EXAMPLES: APPLETON ZERO FIVE ZERO RADIAL THREE SEVEN MILE FIX; RENO LOCALIZER BACK COURSE FOUR MILE FIX.

b. When a fix is named, state the name of the fix, followed by the phrase D-M-E FIX, or WAYPOINT (a predetermined geographical position along a RNAV route) as appropriate.

EXAMPLES: JAMES D-M-E FIX; JAMES WAYPOINT.

Traffic Clearances and Instructions

An airport traffic controller should issue such traffic clearances and instructions as are necessary for the purpose of controlling and protecting air traffic. You can accomplish this by aiding pilots in the prevention of collisions between aircraft under your jurisdiction.

A clearance issued by an airport traffic control tower is authority for a pilot to proceed only insofar as known air traffic and field conditions are concerned; it does not constitute authority for the pilot to violate any provisions of military or federal air regulations.

Clearances issued by airport traffic controllers are predicated upon known or observed traffic and field conditions which, in the judgment of the controller, affect safety in aircraft operations. Such known traffic conditions include not only aircraft observed in the air within the control zone and on the movement area over which control is being exercised, but also any known or observed vehicular traffic or other obstructions not permanently installed on the movement area in use.

If a clearance issued by the airport traffic controller is not acceptable, the pilot may request and, if practicable, receive an alternate clearance.

Departure Information

Information, as appropriate, is provided to departing aircraft. Information which is currently contained in the Automatic Terminal Information Service (ATIS) broadcast may be omitted if the pilot states the appropriate ATIS code. Runway, wind, and altimeter may be omitted if a pilot uses the phrase "HAVE NUMBERS."

NOTE: ATIS will be discussed later in this chapter.

In the examples listed below, the runway in use, surface wind, and the altimeter setting may be omitted from taxi instructions if the pilot states have numbers as discussed in the previous paragraph. However, you should be alert to provide this information if it is apparent that a change has taken place since the last recorded data was broadcast.

The following information, as appropriate, is issued to departing aircraft:

1. Runway in use.

EXAMPLE: TAXI TO RUNWAY TWO FOUR LEFT; or, RUNWAY TWO FOUR LEFT.

2. Surface wind.
3. Altimeter setting. Unless specifically requested by the pilot, this need not be issued to local aircraft operators who have requested this omission in writing or to scheduled air carriers.
4. Time check, when requested.
5. Issue the official ceiling and visibility to a departing aircraft before takeoff as follows:

   a. To a VFR aircraft—when weather is below VFR minima.

   b. To an IFR aircraft—when weather is below that published as the highest takeoff minimums for the airport, or if none are published, when weather is below VFR minimums.

6. Taxi information as necessary. Taxi route information need not be issued unless specifically requested by the pilot.
7. Inform departing IFR aircraft of the appropriate departure control frequency. This may be issued on the clearance delivery or ground control frequency.

The following is an example of departure information issued in response to a request from the pilot of a departing IFR aircraft:

NAVY ONE THREE SEVEN, MAYPORT GROUND, RUNWAY TWO FOUR LEFT, WIND TWO ONE ZERO AT ONE FIVE, ALTIMETER THREE ZERO ZERO ONE, TIME ONE FOUR ONE FIVE AND ONE QUARTER, TAXI EAST ON THE PARALLEL TAXIWAY, DEPARTURE CONTROL FREQUENCY WILL BE THREE TWO FIVE POINT TWO.

Normally, the taxi instructions issued permit an aircraft to proceed to a specified point without delay or confliction to other traffic under tower jurisdiction. If in the judgment of the controller, a potential conflict exists, taxiing aircraft must

be held short of the area in which the conflict may exist to await further instructions. Issue concise and easily understood taxi information.

An example of taxi instructions from one point to another on the movement area is as follows:

NAVY TWO ONE SEVEN TURN RIGHT AT THE FIRST INTERSECTION, TAXI STRAIGHT AHEAD TO END OF TAXIWAY, THEN TURN LEFT.

Taxi instructions subsequent to the above are as follows:

NAVY TWO ONE SEVEN TAXI ACROSS RUNWAY TWO FOUR, CONTINUE TAXIING, STRAIGHT AHEAD, TURN LEFT AT THE NEXT INTERSECTION TO OPERATIONS.

A pilot receives instructions to proceed to a certain runway, but no holding instructions are given. In the absence of holding instructions, the pilot may cross all runways which the taxi route intersects except the assigned runway.

Takeoff Clearances

The takeoff clearance, as the name implies, is issued after the aircraft has taxied to the warmup area at the end of the runway. The pilot has previously received information on the runway in use, wind direction and velocity, the altimeter setting, and time check. By making the statement to the tower, READY FOR TAKEOFF, the pilot is saying, "I am interested in obtaining authorization to commence takeoff, and need information on local traffic that may affect my flight while in the control zone."

Takeoff clearance should be issued in the following form:

1. (Identification).
2. (Any pertinent information).
3. (Wind information).
4. CLEARED FOR TAKEOFF.

EXAMPLE: NAVY THREE TWO ONE, WIND ONE TWO ZERO AT FIVE, CLEARED FOR TAKEOFF.

Immediately after takeoff, many pilots want their time off the ground. An example of a response to such a request is as follows:

NAVY ONE TWO THREE, OFF AT ONE SIX.

Cancellation of a previously issued clearance for takeoff shall be issued as follows:

EXAMPLE: CANCEL TAKEOFF CLEARANCE.

Aircraft may be authorized to taxi into takeoff position and hold when takeoff clearance cannot be issued because of traffic. Traffic information should be issued such aircraft unless the traffic is another aircraft which has landed or is taking off on the same runway.

EXAMPLE: TAXI INTO POSITION AND HOLD (traffic information, if required).

Aircraft CANNOT be authorized to taxi into position to hold for an unreasonable length of time before takeoff clearance can be issued or to hold simultaneously on intersecting runways.

When issuing additional instructions or information to an aircraft holding in takeoff position, include instructions to continue holding or taxi off the runway, unless it can be cleared for takeoff.

EXAMPLE: CONTINUE HOLDING; or, TAXI OFF THE RUNWAY.

Clearance for a requested right/left turn after takeoff is given at the discretion of the controller based on the existing traffic situation, and is usually included with the takeoff clearance. This is stated as:

RIGHT/LEFT TURN APPROVED, (WIND INFORMATION), CLEARED FOR TAKEOFF.

In the event an aircraft is on final approach and there is still sufficient time to clear a departing aircraft for takeoff, the following phraseology should be used:

CLEARED FOR IMMEDIATE TAKEOFF.

In the event an aircraft is on final approach and there is still sufficient time to clear a departing traffic aircraft which is in takeoff position, but some doubt exists as to whether or not the departing aircraft will take off immediately, the following phraseology should be used:

TAKE OFF IMMEDIATELY OR TAXI OFF THE RUNWAY.

Intersection takeoffs may be authorized to expedite the movement of traffic. Such procedure may be initiated by a controller or in response to a pilot's request. If a pilot requests the distance from the intersection to the end of the runway, the measured distance from an appropriate chart constructed for this purpose is issued.

Prior to issuing takeoff clearance to IFR jet aircraft, the local controller should instruct the pilot to change to the departure control frequency (where this service is provided).

EXAMPLE: CHANGE TO DEPARTURE, WIND ONE TWO ZERO AT FIVE, CLEARED FOR TAKEOFF.

In the event that it becomes necessary for the local controller to communicate with the aircraft after the pilot has changed frequencies and the tower possesses override capability, the controller may transmit urgent instructions directly to the aircraft on this frequency.

If the tower does not possess override capability, aircraft are also instructed to monitor the emergency frequency. Any messages or instructions of an urgent nature are then transmitted to the aircraft on the emergency frequency.

EXAMPLE: CHANGE TO DEPARTURE MONITOR GUARD, WIND ONE TWO ZERO AT FIVE, CLEARED FOR TAKEOFF.

If the appropriate mode/code beacon assignment has not been previously made, this should be included in the takeoff clearance.

EXAMPLE: SQUAWK TWO THREE ZERO ZERO, CHANGE TO DEPARTURE, WIND ONE TWO ZERO AT FIVE, CLEARED FOR TAKEOFF.

Avoid requiring pilots to make radio frequency or beacon changes before the aircraft reaches 2,500 feet above the surface for turbojet aircraft, or the MEA, if lower, for A-1 aircraft.

Landing Information and Instructions

Instructions to enter the traffic pattern to approach the airport and land must include the following:

1. Specific traffic pattern information. (May be omitted if the aircraft is to circle the airport to the left.)

EXAMPLES:

ENTER LEFT/RIGHT BASE.

STRAIGHT-IN.

MAKE STRAIGHT-IN.

STRAIGHT-IN APPROVED.

RIGHT TRAFFIC.

MAKE RIGHT TRAFFIC.

RIGHT TRAFFIC APPROVED.

CONTINUE.

2. Runway in use.

3. Surface wind direction and velocity. (When the aircraft is being controlled by a radar facility not having wind measurement equipment, relay this information to the radar controller at the time low approach, landing, or touch-and-go clearance is issued.)

4. Altimeter setting.

5. Any supplementary information.

6. Clearance to land (when appropriate).

7. Requests for additional position reports, when required.

Using the above form, instructions governing a flight from a visual reporting point, holding

point or fix, or other outlying point to the traffic pattern are stated as follows:

NAVY THREE TWO NINER, NAVY MEMPHIS TOWER, ROSEMARK AT TWO THOUSAND, ENTER DOWNWIND, RUNWAY THREE SIX, WIND ZERO ONE ZERO AT ONE FIVE, REPORT ENTERING DOWNWIND.

Instructions to a jet aircraft that uses the overhead type of approach is as follows:

NAVY FOUR ONE FIVE, OCEANA TOWER, FIVE MILES SOUTH AT TWO THOUSAND, RUNWAY THREE TWO LEFT, WIND THREE ONE ZERO AT ONE FIVE, REPORT INITIAL.

It should be noted that information which is contained in the ATIS broadcast (as mentioned in the section covering departure information) need not be transmitted to aircraft if the pilot indicates knowledge of this data by stating the appropriate ATIS code.

Items 1, 2, 3, and 4 previously listed need not be repeated if the pilot states "HAVE NUMBERS" or a similar phrase and the information is still current.

NOTE: Refer to chapter 10 for detailed descriptions of traffic patterns and control techniques applicable to arriving traffic.

The instructions to enter a traffic pattern should not be confused with the clearance to land since the former is issued when the aircraft is some distance from the field and traffic conditions usually do not permit the issuance of a landing clearance at that point.

Clearance to land should be given as follows:

NAVY THREE TWO NINER, WIND CALM, CLEARED TO LAND.

In the event aircraft are landing and taking off at an airport without coming to a stop during their landing roll, such operations are described as touch-and-go landings. Pilots are required to request approval of same at least by the time they are turning on their final approach leg. Approval for such operation should be issued by use of the following phraseology:

WIND CALM CLEARED FOR TOUCH-AND-GO.

In the event it is not possible to approve a requested touch-and-go operation, but a full stop landing can be approved, the following phraseology is used:

UNABLE TO TOUCH-AND-GO, MAKE FULL STOP LANDING OR GO AROUND (CIRCLE THE FIELD).

If an aircraft cannot be cleared to land and it is desired that it continue to circle the airport, the following phraseology should be used:

CIRCLE THE AIRPORT.

When it is desired to delay an aircraft in effecting separation, and a normal circle of the field would take more than the required time, the following phraseology should be used if circumstances permit:

MAKE LEFT/RIGHT THREE SIXTY/ TWO SEVENTY.

When an aircraft is on final approach and it becomes necessary to cancel the landing clearance, the following phraseology should be used:

GO AROUND.

Whenever it is desired that the pilot shorten the approach path, the following phraseology should be used:

MAKE SHORT APPROACH.

When it is desired that the pilot lengthen the downwind leg, the following phraseology is used:

EXTEND DOWNWIND.

To inform pilots of arriving aircraft of their respective positions in the traffic pattern landing sequence, the following phraseology may be used:

NUMBER (landing sequence number).

If it is desirable or necessary to be specific and indicate that an arrival follow a particular aircraft in the traffic pattern, the following phraseology may be used:

FOLLOW (description and location of traffic).

If other landing traffic is utilizing a runway different from that which an arriving aircraft will use, traffic information should be issued to the arrival as follows:

TRAFFIC IS (description and location of traffic). LANDING RUNWAY (number).

When describing location, descriptions such as TO YOUR RIGHT, ABOVE YOU, ONE MILE AHEAD OF YOU, etc., are much more satisfactory than NORTH OF YOU, ONE MILE EAST OF YOU, etc.

Remind aircraft to check wheels down when it reaches an appropriate position in the traffic pattern, unless the pilot has previously reported wheels down, as follows:

CHECK WHEELS DOWN.

Landing clearance should not be issued to an arriving aircraft until a WHEELS DOWN report is received.

Controllers should make a visual check of all landing aircraft to ensure that wheels are actually down. It is possible that a pilot may receive an erroneous indication from the wheels down light in the cockpit.

This visual sighting is normally made with the binoculars found in all control towers.

In the event an aircraft has encountered landing gear difficulty and has to proceed within close proximity of the control tower for personnel to observe the landing gear, the following phraseology should be used:

1. If the landing gear appears to be in a normal position, the control tower personnel should transmit:

LANDING GEAR APPEARS DOWN AND IN PLACE.

2. If the landing gear does not appear normal, a description of the appearance should be given, as for example:

RIGHT WHEEL APPEARS RETRACTED, or LEFT WHEEL DOES NOT APPEAR IN PLACE.

Additional Phraseology

Controllers approve or disapprove pilots' requests as circumstances and traffic conditions permit. In cases where specific phraseology is not set forth for the applicable procedure, use of the words APPROVED, or UNABLE (include reason and/or additional instruction when necessary), as appropriate.

EXAMPLES: FREQUENCY CHANGE APPROVED; UNABLE HIGH SPEED LOW APPROACH, SLOWER TRAFFIC IN THE PATTERN.

The word IMMEDIATELY is used in phraseology only when expeditious compliance is required to avoid an imminent situation. If time permits, the reasons for this action should be included.

ACs should refer to the appropriate sections of TATC Handbook 7110.65 (Series) for additional phraseology not included here or for possible changes thereto.

EXERCISE

9-23. List five acceptable responses to a request for a radio check.

9-24. Match the words or phrase in Column A with its explanation in Column B by placing the letter of the item in Column B

in the space provided in Column A. Use each Column B item only once or not at all.

Column A	Column B
____1. CHARLIE GOLF	a. Acceptable call sign (pilot's name) of an aircraft in distress.
____2. CHARLIE GOLF TWO SIX	b. Call sign of a civil aircraft when the President's family is aboard.
____3. NAVY CHARLIE GOLF TWO SIX	c. Call sign of any aircraft when the President's family is aboard and the U.S. Secret Service or White House Staff determines it necessary.
____4. VICTOR TWO SIX ROMEO	d. Military Communications Station
____5. MIAMI CENTER	e. NORAD interceptor.
____6. NAVY JACKSONVILLE RADIO	f. ARTCC.
____7. EXECUTIVE ONE FOXTROT	g. Navy training command aircraft.
	h. Navy helicopter
	i. An RNAV route.

9-25. Match the word or phrase in Column A with its meaning in Column B by placing the letter of the item in Column B in the space provided in Column A. Use each Column B item only one or not at all.

Column A	Column B
____1. OUT	a. Check with originator.
____2. WILCO	b. This conversation is ended and no response is necessary.
____3. ROGER	c. Proceed with your message.
____4. OVER	d. I have received your message, understand it, and will comply.
____5. STANDBY	e. I have received all of your last transmission.
	f. Please say every phrase twice.
	g. My transmission is ended and I expect a response
	h. I must pause for a few seconds.
	i. An error has been made in the transmission.

ATC RECORDERS

Learning Objective: **State the uses and operating procedures of the ATC voice recorder.**

NOTE: Voice recorder-reproducers are discussed in Chapter 10 of this manual.

RECORDING OPERATING POSITIONS

Each Navy ATC facility records all radio circuits, interphones, and telephones used for the control of air or vehicular traffic, including crash phone circuits continuously during the hours of operation. Generally, each operating position is recorded on a single, separate recorder channel. This is the desired method of recording because all of the activities of that position are easy to follow should the need arise to analyze an event. However, OPNAVINST 3721.1 requires that the following frequencies be recorded independently:

1. UHF Emergency (243.0 MHz)
2. VHF Emergency (121.5 MHz)
3. Primary Local Control (Tower)
4. Primary Approach Control

RECORDERS USE

Voice recording and digital video recording (where installed on RADAR) are required to provide information for the following uses:

1. Determining adequacy and accuracy of air traffic control instructions, especially during emergencies or heavy traffic
2. Conducting aircraft incident or accident analysis
3. Immediately playing back incidents to aid search and rescue efforts
4. Periodically evaluating circuit loads to determine the need for corrective measures
5. Conducting voice training of air traffic controllers.

All recorders are checked for proper operation at the beginning of each watch. If the recording equipment fails, all flight clearances and control data must be entered on the appropriate flight progress strips described in Chapter 7. This information shall include:

1. Time control is assumed or aircraft handed off
2. Position and time radar contact established or lost or radar service terminated
3. Missed approach
4. Altitude changes
5. Other information pertinent to the traffic situation.

RETENTION OF TAPES

Recorder tapes are changed by Electronics Maintenance personnel (ETs) and are stored in locked cabinets under the custody of the Electronics Maintenance Officer (EMO). All voice and video recordings are retained for a minimum period of 15 days, except those pertaining to an incident or accident, which are retained until no longer required for investigation.

Voice and video recordings are made available to ATC facility supervisory personnel for training or any of the other four above described situations. Recordings pertaining to aircraft accidents or incidents are only released to the ATC Facility Officer or his designated representative, for the purpose of making a written transcript and/or re-recordings. The procedures used in making transcripts and copies of original voice recordings are delineated in OPNAVINST 3721.1.

EXERCISE

9-26. Which operating positions and frequencies will be recorded on independent channels?

9-27. What action should be taken when a recorder is found not to be producing high-quality recordings?

9-28. For what period of time are recorders normally retained?

9-29. What publication would you refer to for the proper procedures used when making a transcript of a tape involving an aircraft accident?

AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS)

Learning Objective: **Identify the purpose, contents, and procedures associated with ATIS.**

ATIS

As a controller, you must be especially alert in a high-activity terminal area. Increased traffic volume, aircraft climbing or descending, and the pilot's preoccupation with his cockpit duties are factors that increase the accident potential within the terminal area. These situations make your job more demanding and require frequent transmissions by you as well as by the pilot. This results in frequency congestion which makes it difficult for you to provide routine information to aircraft under your control. This is highly undesirable from a safety standpoint. Automatic Terminal Information Service (ATIS) was developed to reduce this frequency congestion.

ATIS is the continuous broadcast of recorded noncontrol information consisting of operational, meteorological, and NOTAM data on a predetermined voice outlet associated with a specific NAVAID—normally the UHF NDB (non-directional beacon) at naval facilities. You will find that ATIS reduces frequency congestion by automating transmissions of routine information that otherwise must be issued to aircraft on initial contact. Therefore, your effectiveness is increased, enabling you to handle a large number of aircraft simultaneously.

The responsibility of preparing the ATIS tape is assigned to a specific pertinent position of operation, normally the tower flight data position. This responsibility includes updating and

monitoring ATIS broadcasts and circulating updated messages to appropriate operating positions. The ATIS message is made a matter of record either on the facility recorder, or in writing, in accordance with established directives. If a written record is used, that record must be retained for a period of 15 days.

CONTENT OF ATIS BROADCAST

ATIS broadcasts should be as brief and concise as possible. Normally, the message should not exceed 60 seconds. Only those NOTAMs which affect departures and arrivals should be included in the ATIS broadcast.

A specific phonetic alphabet code shall identify each ATIS message. The first recording each day shall be coded "ALFA" and subsequent updated messages with succeeding alphabet codes. The same alphabet codes shall not be repeated in the same day until all the code letters in the alphabet have been used sequentially. A new recording shall be made when a revised weather observation is received or there is a change to other pertinent recorded data. When frequency changing conditions exist or other circumstances warrant, the broadcast may contain general information followed by: CEILING/VISIBILITY/ALTIMETER/(other conditions) WILL BE ISSUED BY APPROACH CONTROL.

NOTE: ATC procedures that you, as a controller, should use when ATIS broadcasts are available are contained in FAA Handbook 7110.65 (Air Traffic Control).

The content and sequence of an ATIS broadcast is as follows:

1. Airport identification and phonetic alphabet code
2. Weather information consisting of ceiling, sky conditions, visibility, wind direction and speed, and pertinent remarks
3. Altimeter setting
4. Instrument approach in use
5. Landing runway
6. Take-off runway
7. Pertinent NOTAMs
8. Other pertinent information
9. Request pilot acknowledgement of ATIS message on his initial contact
10. Repeat phonetic alphabet code.

EXAMPLE:

"THIS IS OLATHE AIRPORT INFORMATION BRAVO. MEASURED CEILING TWO THOUSAND OVERCAST, VISIBILITY SIX, SMOKE, WIND ONE SIX ZERO AT FIVE. ALTIMETER TWO NINER NINER TWO. PRECISION APPROACHES BEING CONDUCTED TO RUNWAY ONE THREE. LANDING AND DEPARTURES RUNWAY THREE SIX. NOTAM NAVY OLATHE TACAN OUT OF SERVICE. INFORM GROUND CONTROL OR TOWER ON INITIAL CONTACT THAT YOU HAVE RECEIVED INFORMATION BRAVO."

Frequencies utilized for ATIS broadcasts are listed in the COMMUNICATIONS section of the AERODROME/FACILITY DIRECTORY (Enroute Supplement). Pilots are expected to listen to ATIS broadcasts when available, and acknowledge receipt on initial contact by repeating the alphabetical code word given with the broadcast. Example: "INFORMATION BRAVO RECEIVED." Upon receiving pilot acknowledgement, you may omit information currently contained in the ATIS broadcast. However, you must issue pertinent information to pilots who do not acknowledge receipt or who acknowledge an obsolete broadcast. You can readily see that ATIS, when properly utilized, enables you to focus more attention on the separation of air traffic which is your primary responsibility.

EXERCISE

9-30. How do you know if a pilot has received the correct ATIS broadcast?

9-31. What do you do if a pilot acknowledges an incorrect or outdated broadcast?

9-32. What does ATIS stand for and briefly explain what it is.

9-33. Does ATIS aid controllers in the control of terminal traffic? Explain.

CHAPTER 10

CONTROL TOWER EQUIPMENT AND OPERATIONS

At any location where terminal air traffic control operations are conducted, the control tower is the hub of the ATC complex. It is from this hub that all clearances for landings and takeoffs originate, even though the aircraft may be under the direct control of a radar approach control or ground controlled approach (GCA) facility. The tower local controller is the final authority in determining the use of the runway. During periods when both VFR and IFR air traffic is arriving and departing, the tower controller makes the decisions and accomplishes the coordination necessary to blend these operations into a smooth and properly sequenced flow of traffic.

You, the air traffic controller, are located at an airport. Your job is to effect the safe, orderly movement of aircraft as well as to control vehicular and pedestrian traffic on the airfield. To do this, you use radios and other signaling devices to provide information and instructions relative to the traffic and airport conditions.

The purpose of this chapter is to introduce you to some of the various types and pieces of equipment found in control towers throughout the Navy. In addition, this chapter introduces you to the primary duties of a tower controller and the control procedures you will use.

The equipment and methods of operation discussed in this chapter are considered to be most widely in use at this time. As new methods and equipment are installed at duty stations, it behooves every air traffic controller to study diligently, not only the method of operation, but the capabilities and limitations of the equipment and the techniques used.

STANDARD CONTROL TOWER EQUIPMENT

Learning Objective: **Identify and describe the use of various equipments found in most naval control towers.**

JOINT ELECTRONICS TYPE DESIGNATION SYSTEM

The Joint Electronics Type Designation System (JETDS), formerly known as the AN nomenclature system, was developed to standardize, within the DOD, identification of electronic material and associated equipment.

This system of type designations applies to developmental, preproduction, and production models of systems, groups, components, and subassemblies of electronic equipment for military use. Once assigned, a type designation will never be duplicated. In the JETDS, nomenclature consists of a name followed by a type designation, which is composed of indicator letters and an assigned number. The type designation will always apply to one specific article or any subsequent improvements that may be made on that article.

A type designation assignment for a complete system, or set, consists of an AN (which is used to identify major items of electronic equipment),

a slant bar, a series of three letters, a hyphen, and a number. The meanings of the three letters following the slant bar may be found in the table included in this manual as appendix E.

An example of a type designator would be Radar Set AN/SPS-10, which is a surface search radar set designed for installation aboard ship.

COMMUNICATIONS CONSOLES

Radio is the primary means of communications with aircraft, both in the air and on the ground. Different radio frequencies are established for a particular type of operation. For example, most Navy towers have 340.2, 360.2, 142.74, and 126.2 assigned specifically for airport traffic control purposes. Additional frequencies may be established by appropriate authority at some facilities depending upon operational requirements. Different operating positions within the same facility may have to share the same frequency for a single aircraft operation. For example, single piloted IFR aircraft should be provided a single frequency approach (SFA) to the maximum extent that communications and traffic conditions permit. Therefore, approach control, radar facility, and the control tower may find it necessary to use the same frequency sometime during such an operation. Additionally, interfacility communications may be necessary for coordination between the different operating positions where physical contact between controllers is not possible. To provide you with this capability, communications consoles are provided which allow selection of various frequencies and intercommunications between your position and other operating positions.

AN/FSA-52(V) Communications System

The AN/FSA-52(V) Communications Control System is used by many naval air traffic control facilities. This system provides communications control consoles for up to 23 controllers and one supervisor. The supervisor's console can control up to 60 radio transmitters and receivers or 10 "Hot Line" telephone lines and 50 radio transmitters/receivers.

Each controller's console may be programmed to provide control of as many as 20 transmitters with a lockout feature that denies the use of a transmitter to any other operator once selected. It also monitors as many as 20 radio receivers at any one time. In addition, you can talk to one or more operators on the interphone feature. The interphone feature allows private line or party line intercommunication.

The operation of the console is simple, once the confusion of the number of controls is overcome. (Figure 10-1 shows the names and uses of many of these controls.) Located on the right side of the console is a microphone level indicating meter, level controls for the microphone and headphone, and a dimmer control for lights, as well as selection switches. The 3-position radiophone switches control the receivers and transmitters. These switches are OFF in the down position. To monitor a frequency, you move the switch to the middle position. To select a transmitter, while monitoring the frequency, just move the switch to the top position. The radiophone frequency chart is a removable strip of translucent plastic placed below the radiophone switches. The frequency controlled by each switch may be written on this chart for ready reference. Above each switch is an amber light which glows when a radio call is received, regardless of the position of the switch. A green light immediately above each amber light will glow when a transmitter is selected by a corresponding switch.

The 23 interphone switches on the bottom of the console control the 23 private line interphone circuits. The switches are OFF in the down (middle) position. To call and talk to another operator, you move the switch corresponding to the desired operator to the up position. Above each interphone switch is a red light which glows when your position is called by another operator (the one corresponding to the number under the light). The supervisor interphone switch provides a private line interphone circuit to the supervisor's console in the same manner as the other interphone switches.

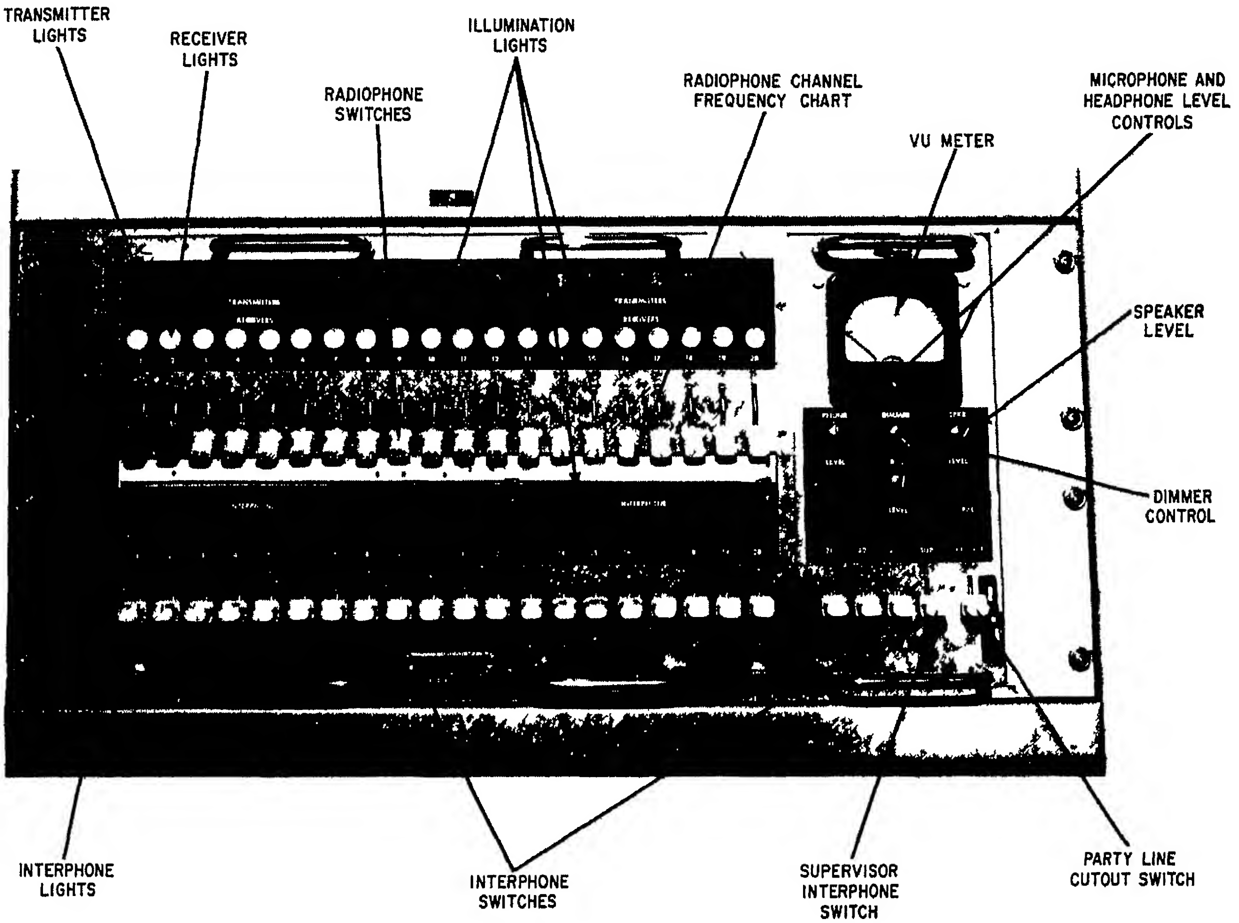

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Figure 10-1.—AN/FSA-52(V) controller's console.

The party line cutout enables you to disconnect from a party line (programmed into the system) by moving the switch up.

The speaker level control is used to control the speaker volume. The dimmer control is used to adjust panel illumination intensity. The speaker is automatically muted at the transmitting console when transmitting. Side tone is simultaneously transferred to the controller's headset.

Other auxiliary equipment, such as a speaker, jackbox, and boom-type headset necessary for controller operation, are shown in figure 10-2. In addition, equipment discussed later in this chapter is shown on top of the panel in front of the controller such as, a digital-type altimeter setting indicator, wind direction and speed indicator, and digital time indicator showing hours, minutes, and quarter minutes. Also shown is a flight progress strip holder.

Figure 10-3 is an overall view of a typical control tower layout showing the various types of equipment used by the control tower operators. A floor-mounted microphone keying foot switch used with the three communications systems described in this chapter is illustrated in figure 10-3.

201.20

Figure 10-2.—AN/FSA-52(V) installation and auxiliary equipment.

AN/FSA-58 Communications Console

The AN/FSA-58 (figure 10-4) is a newer type of equipment which has many new and desirable features. The modular characteristics of this system permit a virtually unlimited expansion of the basic equipment without undue installation of large amounts of additional units.

Some of the features incorporated in this communications equipment are as follows:

1. The console may be mounted with the modules in either a vertical or horizontal manner.
2. There are no limitations as to the number of transmit or receive circuits for radiophone channels.
3. Interphone circuits are available between controllers and between the supervisor and controllers.
4. The supervisor's console contains a power and fault alarm system that gives both a visual and aural signal when trouble occurs within the system.
5. The backup power supply automatically shifts to batteries or standby power source in the event of primary power failure.
6. An individual speaker and volume control is at each control position.
7. An override feature on the supervisor's console.
8. Landline circuits may be patched into the modules.

As you see, this particular piece of equipment is extremely adaptable for use in either the control tower or a radar control room.

A controller's position would normally consist of a minimum of four modules: a speaker

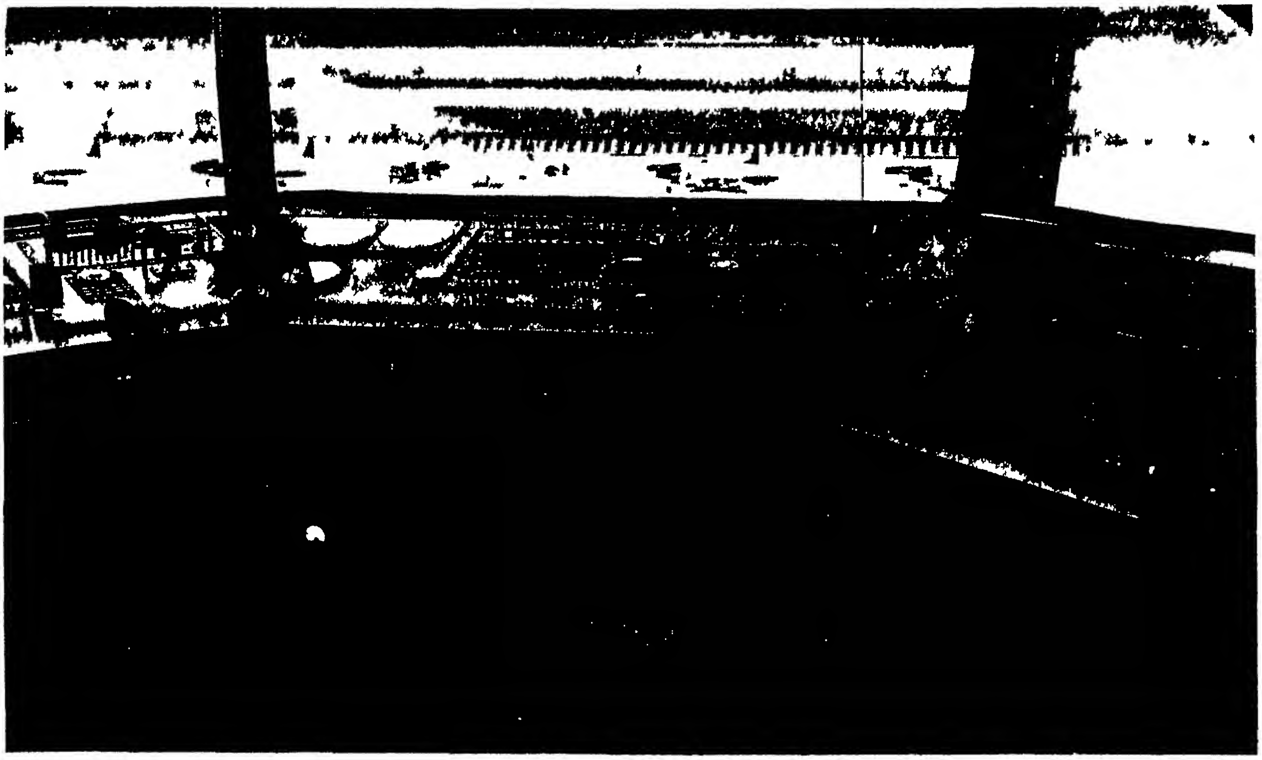

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Figure 10-3.—Control tower layout.

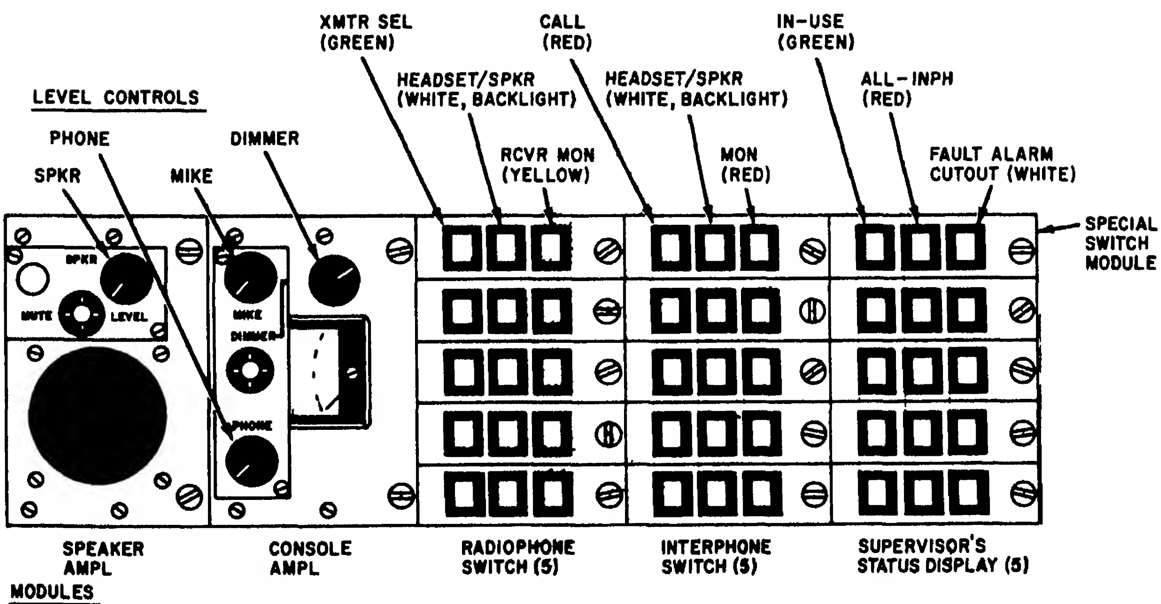

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Figure 10-4.—AN/FSA-58 controller's communication console.

amplifier, console amplifier, radiophone switch (TX/RX), and interphone switch with additional radiophone (TX/RX) modules installed as required.

All pushbuttons are the lighted transparent colored lens type with provisions for identifying frequency, channel number, position, etc. The console amplifier contains a dimmer switch to control the intensity of these lights. (See figure 10-4.)

To operate, select the desired frequency and depress the appropriate XMTR SEL button (green) on the radiophone module. This light will then glow a steady bright. If the desired frequency button is glowing at half brilliance, the frequency is in use by another controller or the supervisor; if you depress it you will hear a busy signal in the headset and the light will flash brightly.

Receiver audio will be heard in the headset when the HEADSET/SPKR button (white) is not depressed; to transfer the receiver to the speaker merely depress this button and adjust the speaker level control for the loudness desired.

If you only want to monitor a particular frequency, simply depress the RCVR/MON button (yellow). With the button pushed in, the light will glow at half brilliance.

Operation of the interphone system is equally as simple; to call another controller or the supervisor, depress the CALL button (red) for the station desired and the lamp will light. The HEADSET/SPKR button operates in the same manner as previously described for the radiophone section.

The monitor button (red) has a momentary push button feature which allows the controller to listen to incoming calls. This light is illuminated when another station is calling.

You can adjust the headphone volume and microphone level by using the controls located on the console amplifier.

In addition to the controls listed on the controller's console, the supervisor can determine which controller is using a particular frequency, what channels the controller has been programed for and can also call all controllers simultaneously on the interphone.

The jackbox (figure 10-5) is used in conjunction with the AN/FSA-52 and AN/FSA-58 communications equipment. It

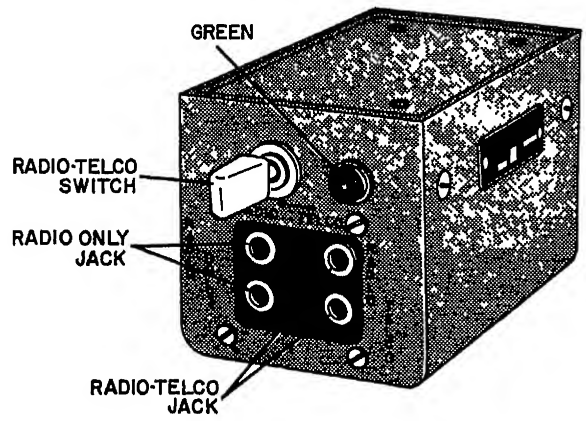

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Figure 10-5.—AN/FSA-52(V) and AN/FSA-58 communications jackbox.

provides two jacks for the headset, one marked RADIO ONLY and the other marked RADIO-TELCO. For operation without landlines installed in the system, the headset would be plugged into the RADIO ONLY jack. When landlines are wired into the console and a controller requires access to them in addition to the normal radiophone channels, the headset would be plugged into the RADIO-TELCO jack. The jackbox is equipped with a switch which allows the controller to change between radiophone and landline circuits. A green light located on the jackbox unit glows when the switch is in the TELCO position. With the switch in the RADIO position received transmissions are heard in the headset. Received transmissions are transferred to the speaker when the switch is placed in the TELCO position.

Standard-type headsets and a foot-operated switch (figures 10-2 and 10-3) are used with the AN/FSA-58(V) communications equipment.

NOTE: Not all Navy control towers have received the newer, state-of-the-art communications consoles. Some towers are still equipped with the AN/FRA 11, three position, 16 channel transmitter/receivers. In addition, some radar facilities and control towers may be equipped with the 20 channel AN/FSA 17 communications console.

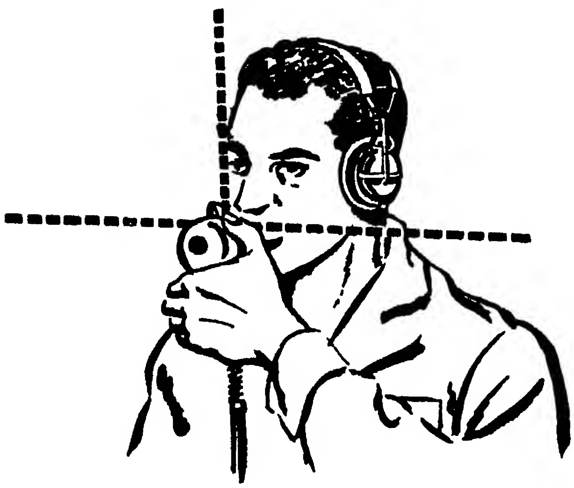

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Figure 10-6.—Hand-held microphone.

MICROPHONES

A microphone is essentially an energy converter that changes sound energy into corresponding electrical energy. When you speak into a microphone, the audio pressure waves strike the diaphragm of the microphone and cause it to move in and out. The diaphragm is attached to a device that causes current to flow in proportion to the pressure applied to the diaphragm.

Types

There are two types of microphones in use today by ATC facilities; they are the hand-held type (figure 10-6) and the headset type (figure 10-7). Both types should be placed directly in front of the mouth, within one-half inch or almost touching the lips. Most hand-held microphones are relatively inefficient, and the slightest variation of microphone position can drastically reduce the intelligibility of the message being transmitted.

Although the older telephone operator style headset is still functional, it is being phased out in ATC facilities. The new style headset that is replacing it is lightweight and fits comfortably behind the ears (see figure 10-8).

Techniques

Proper microphone technique is important in radiotelephone communications. Transmissions should be concise and in a normal conversational

201.23

Figure 10-7.—Headset microphone.

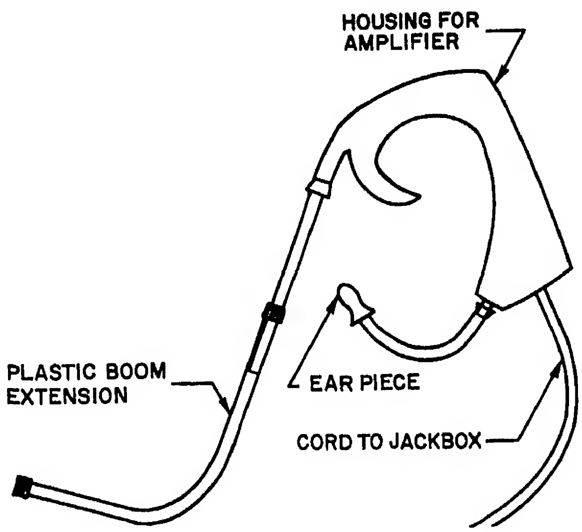

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Figure 10-8.—Lightweight headset microphone.

tone. Consider the following suggestions for proper technique: speak clearly and distinctly; avoid extremes of voice pitch; be natural; use standard phraseologies to the maximum extent practicable, but do not be afraid to use plain language where no precedence has been set; shield your mike from outside noises; keep your mike a sufficient distance from an associated speaker to avoid acoustical feedback.

In radiotelephone communications, the operator of the equipment becomes part of the system. The manner in which the message is delivered determines the effectiveness of the transmitted signal as well as the power and efficiency of the equipment. Figures 10-6 and 10-7 illustrate correct technique for hand-held and boom or headset-type microphones, respectively.

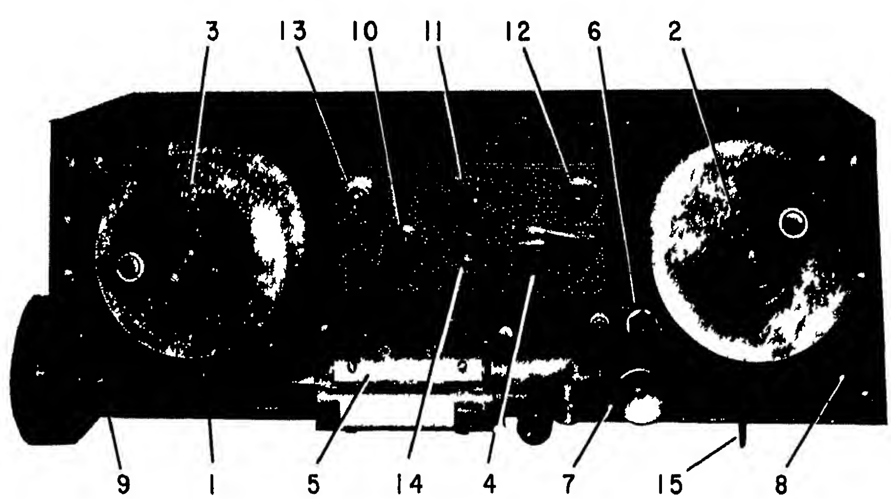
VOICE RECORDERS AND REPRODUCERS

As you learned in chapter 9, the purpose of recorders in air traffic control facilities is to record conversations between controllers and aircraft. These recordings are used for aircraft accident analysis; checks on circuit discipline; analyzin adequacy and accuracy of air traffic contro instructions; immediate playback for assistanc in search and rescue; and for voice training of ai traffic control personnel.

Currently, the navy uses two types of recorder at its ATC facilities: RD-217/UNH an RD-379(V)/UNH. OPNAVINST 3721.1 charge the Electronics Maintenance Division with th maintenance and custody of recorders and tapes However, you may be assigned to make written transcript or a re-recording of an origina recording. Therefore, a brief discussion of th capabilities of both recorders/reproducers i given. If you are assigned to transcribe o re-record a voice recording, the procedures con tained in OPNAVINST 3721.1 shall be strictl adhered to.

Voice Recorder/Reproducer RD-217/UNH

The RD-217/UNH (figure 10-9) is a singl channel recorder/reproducer. It can be used t record a single frequency or a single operatin



1. Handle crank.
2. Empty reel.
3. Full reel.
4. Load lever.
5. Gate and magnetic heads.
6. Rubber pressure roller.
7. Tape feed roller.
8. Tape guide.
9. Tape guide.
10. Record-stop-play selector switch.
11. Volume control.
12. Power indicator lamp.
13. Visual volume indicator.
14. Monitor jack.
15. Tuning lever.

201.

Figure 10-9.—RD-217/UNH front panel controls.

position, such as tower, local control position. The RD-217/UHN provides continuous recording for up to 24 hours plus a 15 minute overtime allowance.

This recorder uses a brown plastic magnetic tape which is two inches wide and 312 feet long. The tape is stamped with two time scales. The scales start at 0000 minutes and end at 1455 minutes (24 hours 15 minutes). In order to locate a specific portion of the recording, you must convert the number to time. For example, if the number is 0200, it indicates that 200 minutes have passed since the tape was started.

Before these tapes can be reused, they must be demagnetized. The MX-1373A/UN Demagnetizer shown in figure 10-10 is used to erase the recorded material from a complete reel of tape.

Voice Recorder/Reproducer RD-379(V)/UNH

The RD-217/UNH is being replaced by the ten-channel RD-379(V)/UNH. This magnetic tape recorder-reproducer, (figure 10-11), is an audio-frequency, solid-state, magnetic-tape

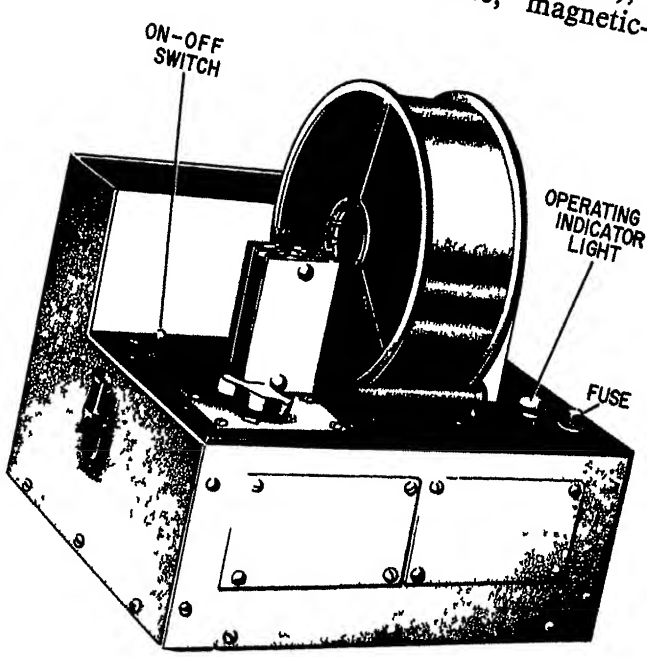


Figure 10-10.—Demagnetizer. 201.27

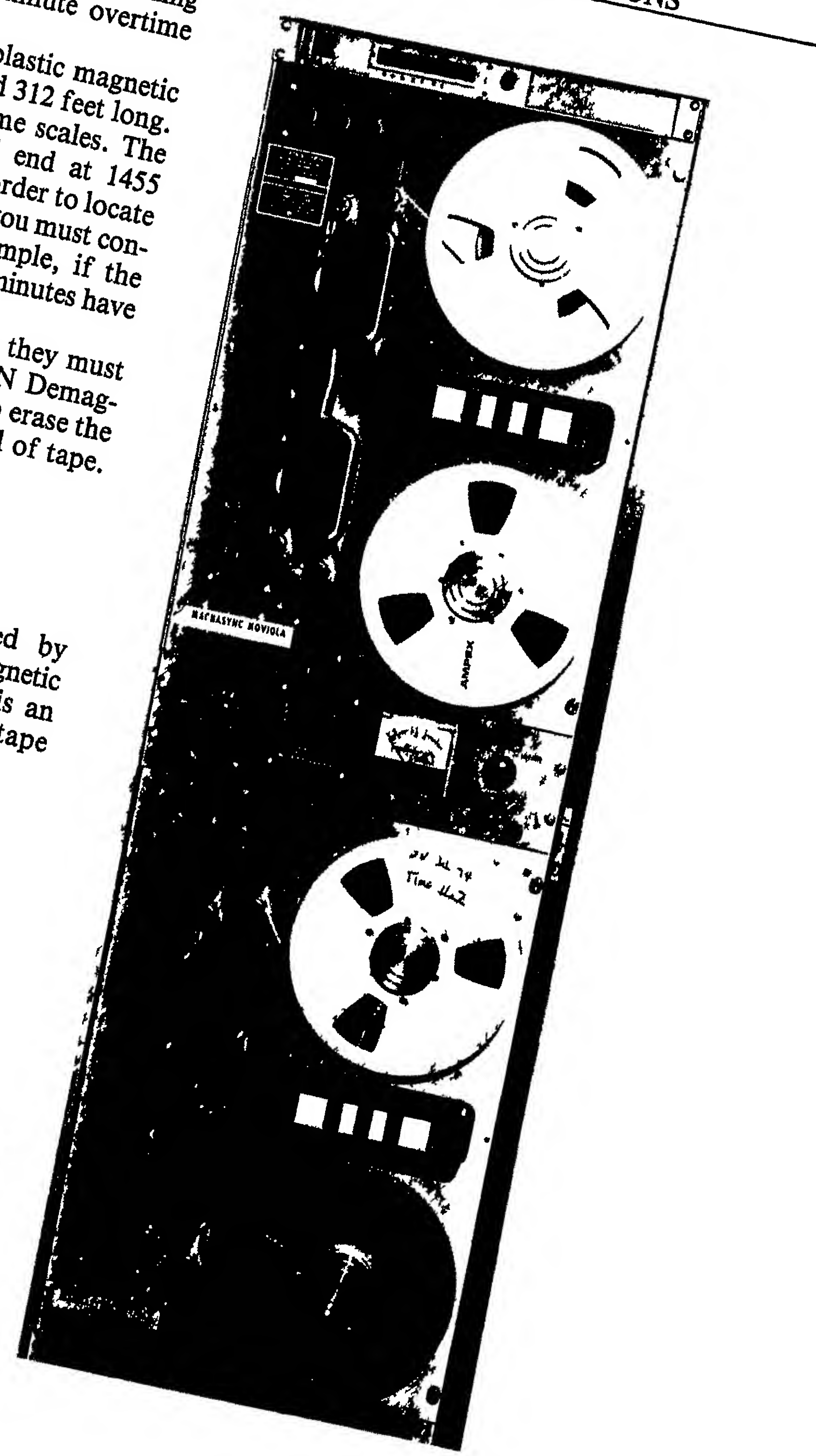


Figure 10-11.—Voice recorder-reproducer RD-379(V)/UNH. 201.240

recording system which can make simultaneous recordings of up to ten channels of audio information. These channels may be either different frequencies or different operating positions. Information stored on the tape may be played back through the reproducer head at the recording site, or the tape may be removed and played back on the separate reproducer RP-214(V)/UN. (See figure 10-12.)

The unit contains two identical tape transport assemblies, one of which is always kept in a standby condition. A fail-safe control tone is continuously recorded and reproduced at a level well below that of the desired voice recording. If the reproduce head fails to pick up this signal (such as, when the tape breaks), recording is automatically switched from the operating transport to the standby transport. When this happens, a loud audio alarm activates at the recording site. This alarm can be extinguished only at the recording site, thus allowing the cause of the alarm to be corrected immediately.

A shorting tap generates a control signal when most of the tape has been used. This signal switches the recording from the used-up transport to the standby transport. These tapes do not have to be erased prior to reuse. The tape automatically erases as it is used for making a new recording.

Any one of the ten channels can be individually monitored on either of the two transports. A rotary switch allows the operator to monitor either the incoming signal or the reproduced signal (which occurs approximately four seconds after the recording is made).

As previously stated, up to ten channels of data may be recorded. It is normal practice to use one of these channels to record an audio time announcement. This recorded time signal is displayed in DAYS-HOURS-MINUTES-SECONDS.

Voice Reproducer RP-214(V)/UN

The magnetic tape reproducer is a portable, audio-frequency, solid-state, magnetic tape reproducing machine with a 10-channel capability. This unit (see figure 10-12) is able to reproduce any three channels simultaneously and monitor them on a loudspeaker or electr headset. Normal playback speed is 15/32 Fast-forward and rewind speed of 150 (minimum) enables cueing and searching specific parts of the recorded tape. Searching a portion of recorded information is extren easy. All you need to know is the time that incident happened and search for it by using recorded time announcement displayed in window located at the top of the reproducer. controls are located on two panels facing operator.

If recording equipment fails, you must e all flight clearance and control data on appropriate flight progress strips. This infor tion shall include:

1. Time control is assumed or airc handed off.
2. Position and time radar contact establis or lost or radar service terminated.
3. Missed approach.
4. Altitude changes.
5. Other information pertinent to the tra situation.

WIND INDICATOR

Wind direction and wind velocity indica are mounted in the control tower to provide with first-hand wind information in order to s the proper runway to use during specified v conditions. They provide a method for pro issuance of wind directions and velocities to pi Also, you may note a marked increase in ve ity, gustiness, or a wind shift that, if rela immediately to the weather service personnel, be significant in impending or approacl weather changes. These instruments are of sev sizes and mounted in various ways in the to

Normally the meteorological instrum located in the tower are "slaves" to the eq ment in the meteorological office. The wind di tion received in the weather office on the "ma set" is "true" direction. On the other hand, directional instruments in the tower must be c pensated for magnetic variation so that you r "magnetic wind," which is what you relay to pilot.

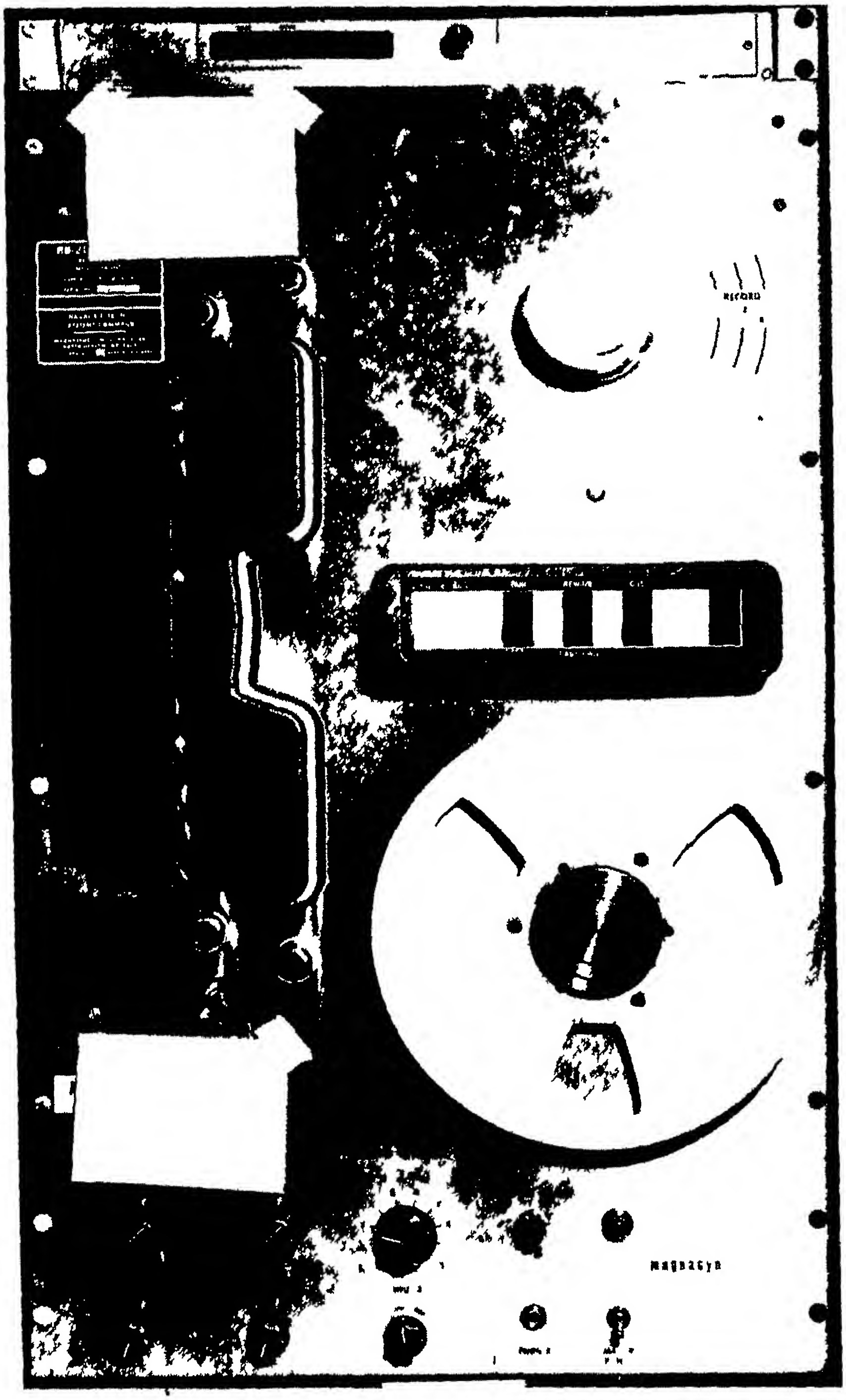


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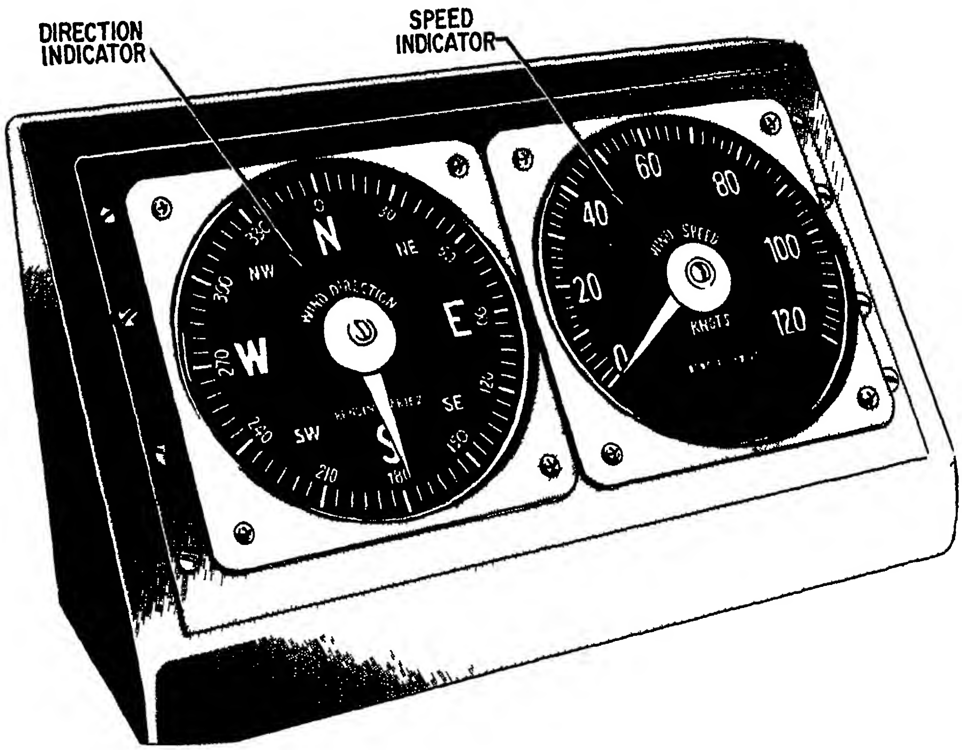
Figure 10-12.—Voice reproducer RP-214(V)/UN.



201.28
Figure 10-13.—ID-586/UMQ-5 wind direction and speed indicator.

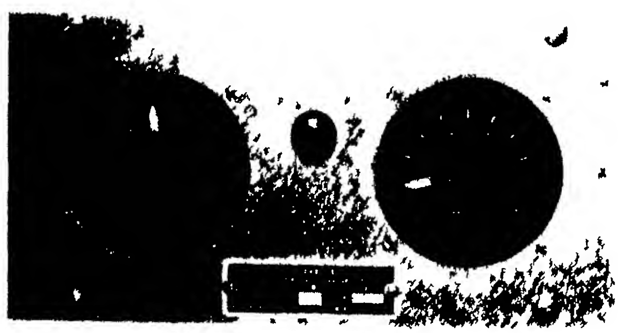
Figure 10-13 illustrates the ID-586/UMQ-5 wind direction and speed indicator which is installed in many Navy control towers.

The wind indicator readings in the control tower must be compared with weather service readings at the beginning of each working day. You should keep in mind that weather service direction is true and variation must be applied to obtain a correct reading. If the wind indicator is in error plus or minus 5 degrees in direction or 5 knots in speed you must notify weather service maintenance personnel so that corrective action can be taken. If the instrument is in error over 10 degrees or 10 knots, it is considered inoperative.

Figure 10-14 shows the ID-1649/UM wind direction and speed indicator which is also used in Navy control towers as well as in many naval radar control facilities.

ALTIMETER SETTING INDICATOR

The altimeter setting indicator is a special form of aneroid barometer so designed that after installation and proper adjustment, the altimeter



201.218
Figure 10-14.—ID-1649/UM wind direction and speed indicator.

setting may be read directly from the scale of the instrument. (See figure 10-15.) The instrument is designed to indicate the altimeter setting when the elevation scale is set to the actual elevation of the instrument above sea level. The mechanism is enclosed in a sealed case with provision for the connection of a venting tube leading to the outside free air.

The altimeter setting indicator is the primary means of obtaining altimeter settings at terminal facilities. You must compare the altimeter setting indicator reading with the official altimeter setting of the weather service between 0800 and 0900 (local time) each day. If there is an error in the instrument of 0.02 but less than 0.04 inch, you write the correction factor on the face of the instrument and add it to/subtract it from readings until weather service maintenance personnel can check the instrument. If the error equals or exceeds .04 inch, the instrument is considered inoperative. In both cases, you should advise maintenance personnel immediately. Also, if the average windspeed is in excess of 40 knots, a correction factor must be used until the average windspeed is less than 40 knots.

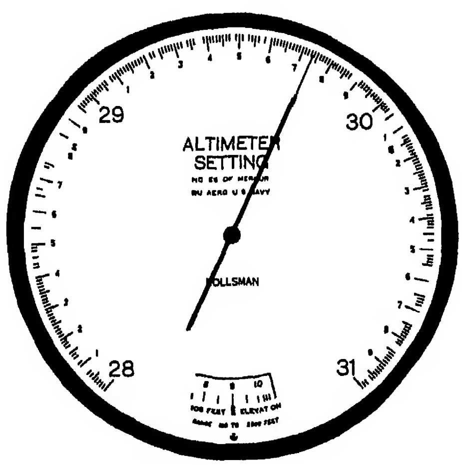
Figure 10-16 is a digital-type altimeter setting indicator that displays the current altimeter setting in 4 digits and is lighted for ease of viewing.

Initially you obtain the altimeter setting from a direct reading indicator (figure 10-15) which may be located in a remote location such as a radar control room or the weather service office. You then dial this setting into the master altimeter setting control panel (figure 10-17) by adjusting the control knobs to the appropriate setting.

With this data set on the master control panel, display to all of the digital-type altimeter setting indicators is automatically accomplished. (See figure 10-16.)

PORTABLE TRAFFIC LIGHT

The portable traffic light is sometimes used to control the movement of personnel and vehicles on the landing area and the landings and takeoffs of aircraft not equipped with radio. It is a directive light which emits an intense, narrow beam. Signals from the light are readily discernible to the pilot of any aircraft visible to the tower operator.



201.29

Figure 10-15.—Altimeter setting indicator.

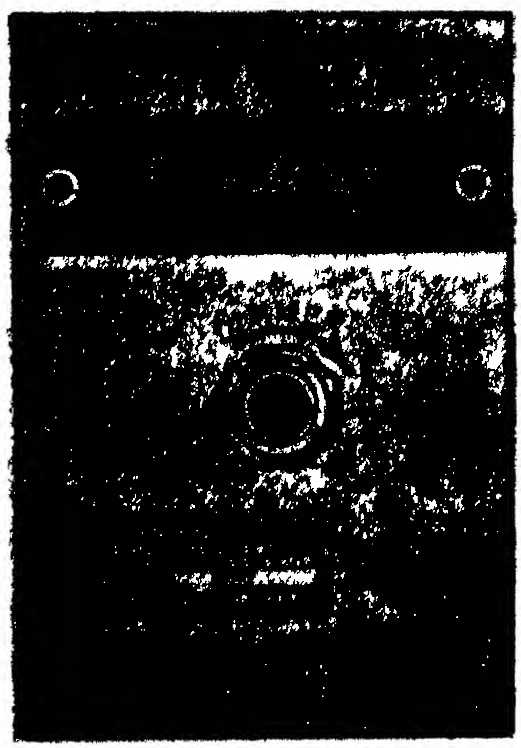


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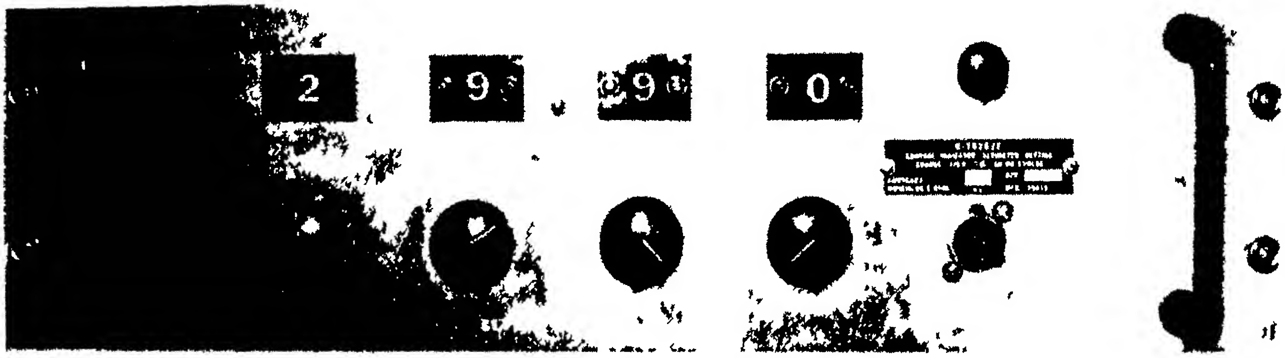
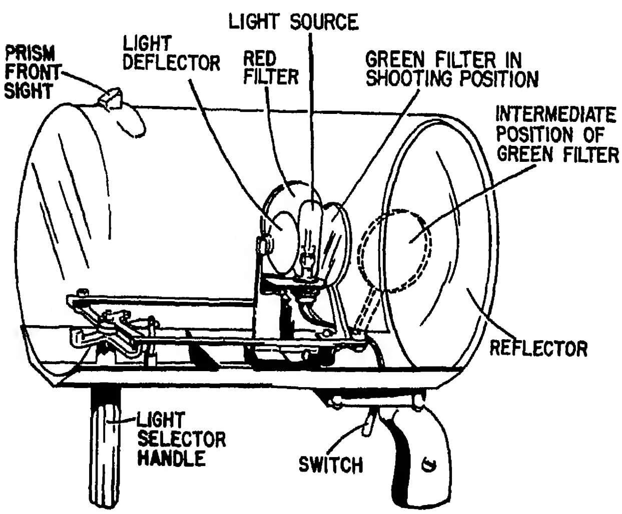
Figure 10-16.—Digital altimeter setting indicator.



201.220

Figure 10-17.—Altimeter setting control panel.

The portable traffic light most commonly used (figure 10-18) consists of a mica composition case, a reflector mounted inside at the back, a mechanism for controlling a choice of three different colored lights, and a socket for a light bulb. The light selector consists of two filters, one red and one green, mounted vertically on two arms that extend into a horizontal position from the front to the back. These arms are connected to the light selector handle underneath the case, thus enabling you to select the appropriate color. In addition, the selector handle aids in aiming the light. By turning this handle fully clockwise, you place the red filter in place, giving a red light; fully counterclockwise puts the green filter in place.



201.33

Figure 10-18.—Portable traffic control light.

The intermediate position, in which neither filter is in place (both at the side of the case) produces the clear or white light. The switch that controls the light is in a pistol-type grip located toward the rear of the light underneath the case. The switch is a spring-loaded toggle switch that automatically opens the circuit when released. This feature enables you to flash the selected color or to hold the toggle switch down when a steady color is desired. The portable traffic light is normally installed in control towers from overhead by means of a cable on pulleys and counterbalanced by weights. This keeps the light within reach for your instant use and in an out-of-the-way position when not in use.

You should be thoroughly familiar with the limitations of the traffic control light, and evaluate its capabilities in connection with its use. The traffic control light has a range of 15 miles at night and 10 miles during daylight hours. It has the following advantages:

1. Requires no radio equipment in the aircraft; therefore, all aircraft can be controlled whether or not they possess a radio.

2. Provides an emergency method of control in event of radio failure—either in the tower or the aircraft.

It has the following disadvantages:

1. The pilot may not be looking at the control tower at the time a signal is given.

2. The information transmitted by a light signal is limited. You may transmit only an approval or disapproval of the pilot's anticipated actions since no explanatory or supplementary information can be transmitted.

The traffic control light is flight-checked at a distance of three miles around the airport at the lowest traffic pattern altitude.

You should not hesitate to use light signals to control traffic, but you must be careful when using the light gun. You must transmit signals in a deliberate manner so the pilot will know the exact nature of the message. For instance, if the pilot is starting across the runway and you give a fast flashing green light, it would, on occasion appear as a steady green light. The pilot in this situation would think that you wanted him to take off rather than to taxi across the runway, and the result would probably be a conflict with other traffic on the crossing runway.

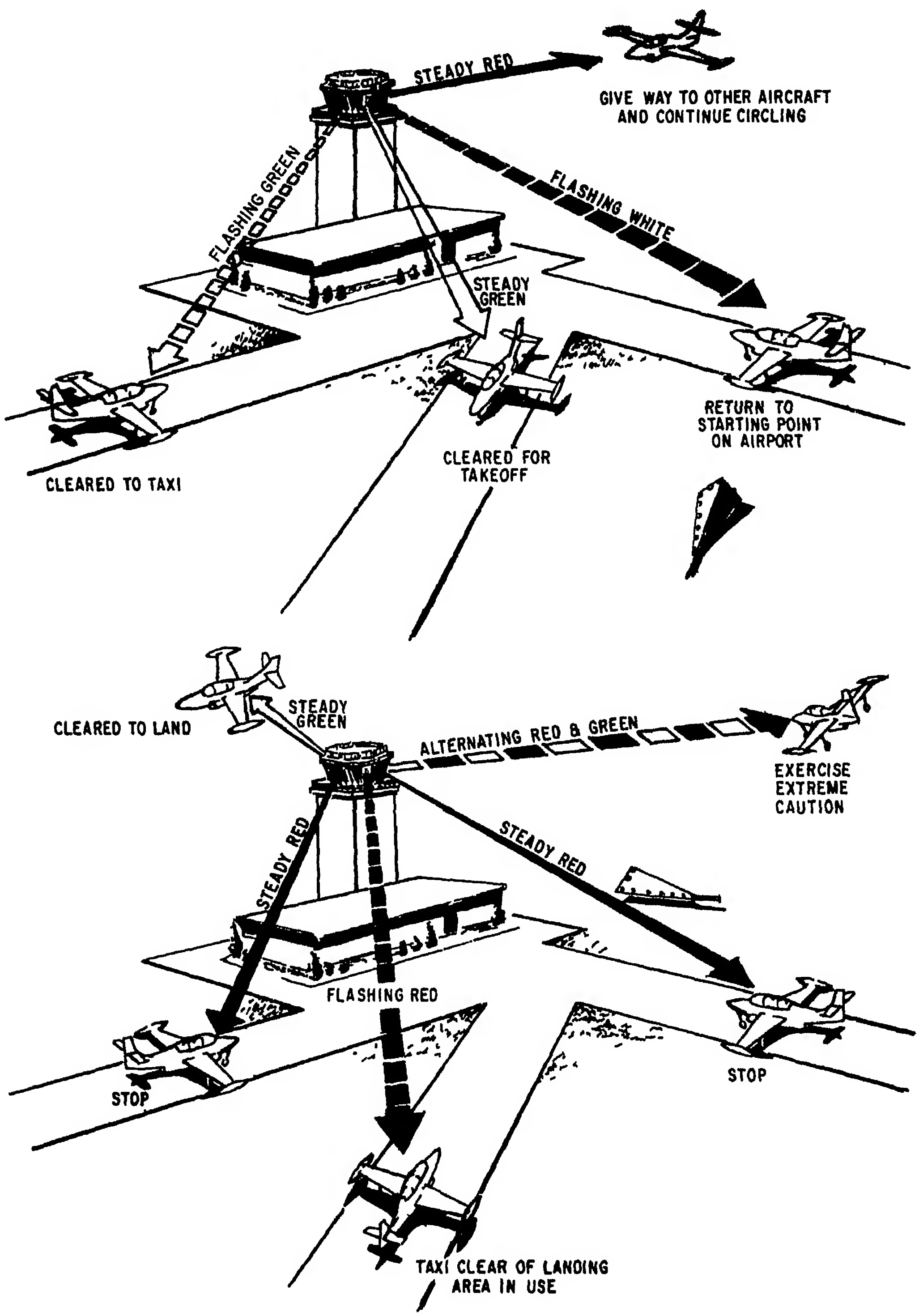
OPNAVINST 3721.1 requires commanding officers to establish airfield vehicle operator's indoctrination courses and local rules which minimize vehicle traffic on aircraft movement areas. It also requires all vehicles in these areas to be radio equipped or to be escorted by radio equipped vehicles. However, light signals may be used for controlling vehicles when the control tower has an outage of radio equipment.

In addition to the operation and limitations of the portable traffic light, you must know the meaning of the traffic control light signals used. Figure 10-19 shows the meaning of the signals to be used for aircraft, vehicles, and personnel on the ground and for aircraft in the air. This is shown in tabular form in table 10-1.

A series of alternating red and green flashes from a directed traffic control light are used as

Table 10-1.—Meaning of traffic control light signals

Color and type of signal	On the ground	In flight
STEADY GREEN	Cleared for takeoff	Cleared to land
FLASHING GREEN	Cleared to taxi	Return for landing (to be followed by steady green at proper time).
STEADY RED	Stop	Give way to other aircraft and continue circling.
FLASHING RED	Taxi clear of landing area (runway) in use.	Airport unsafe—do not land.
FLASHING WHITE	Return to starting point on airport.	Not applicable.
ALTERNATING RED AND GREEN	General warning signal—exercise extreme caution.	



201.131

Figure 10-19.—Meaning of traffic control light signals.

ɜral warning signals to advise a pilot or driver vehicle on the landing area to be on the alert hazardous or unusual conditions. As an nple, the warning signal may be directed to a t to indicate a change of runway, since this prove hazardous if the pilot attempts to land ˌswind.

In controlling traffic by means of visual signals should remember that the warning signal is a prohibitive signal. This means that it may ollowed by either a red or a green light as cir-ɩstances warrant. The general warning signal irected to pilots of the aircraft concerned as ɔws:

1. When aircraft are converging and there is ɔssibility of collision.

2. When hazardous conditions are present and the pilot must be unusually alert in order to complete the operation safely. (Such conditions include obstructions, soft field, ice on runway, and many others.)

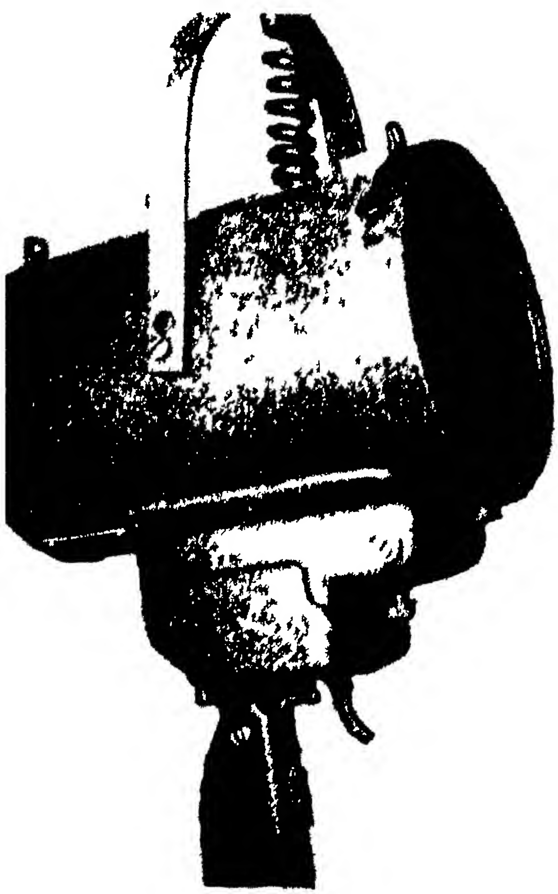
3. When mechanical trouble is apparent to you and you have reason to believe that the pilot may not be aware of it.

4. At any other time you believe it necessary.

Figure 10-20 is an illustration of one of the newer type traffic control lights. Operating principles for this signal light are basically the same as for the one previously described.

CLOCKS

Two basic types of clocks may be found in the control tower: a small direct-reading counter-type clock in both the 12-hour and 24-hour version which also has a quarter-minute drum (figure 10-21) and a direct read digital display type



201.221

Figure 10-20.—Portable signal light gun.

201.34

Figure 10-21.—Direct-reading clock.

(figure 10-22). Some stations have a date-time stamp clock which is most useful for maintaining exact records of the time occurrence of events. Regardless of what type of timing device is used, it must be kept accurate at all times.

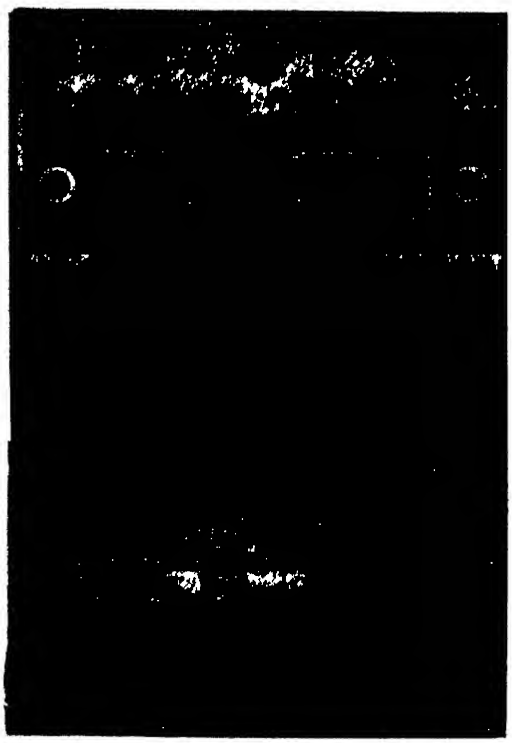
The newer type of time indicator (figure 10-22) is remotely controlled by receiving an input from a master clock which can be located within the ATC facility building.

The time is displayed on the indicator in hours, minutes, and quarter minutes and is lighted in the same manner as the digital-type altimeter setting indicator.

Time checks are obtained from a reliable source, and corrections to the master clock are made as necessary.

NAVAID MONITORS

A malfunction of NAVAID equipment could place a pilot in a critical position; therefore, it is necessary that some automatic means be provided for continuously checking a NAVAID system. This is accomplished by electronic NAVAID monitoring devices which are sometimes located in the tower. Most monitor equipment is similar in that it provides both a light and an aural alarm to indicate that a particular NAVAID is malfunctioning. Some monitor equipment provides for an automatic change-over to standby NAVAID equipment when the main system has failed. Other equipment requires that the standby equipment be "dialed" on, which is a method similar to dialing a telephone with certain codes being dialed for certain functions.



201.222

Figure 10-22.—Digital display clock.

When an alarm system of a NAVAID monitoring device goes off, you should attempt to get the standby equipment in operation, if not automatic. Then notify the technician responsible for maintenance of the NAVAID equipment to provide for rapid repairs.

If the NAVAID has to be shut down or is unreliable, you should immediately notify the appropriate persons or facilities, which are determined locally. These generally include the duty section leader, the appropriate duty officer, the technician who will repair the equipment, the associated approach control if not located in the tower, and the ARTCC in whose area of responsibility the station is located.

Figure 10-23 is an example of an air traffic control console for monitoring NAVAIDs. Basically the AN/GSA-35 provides facilities to perform the following functions:

1. Monitor and display the status of TACAN, VOR, and UHF Homer transmitters at remote locations.

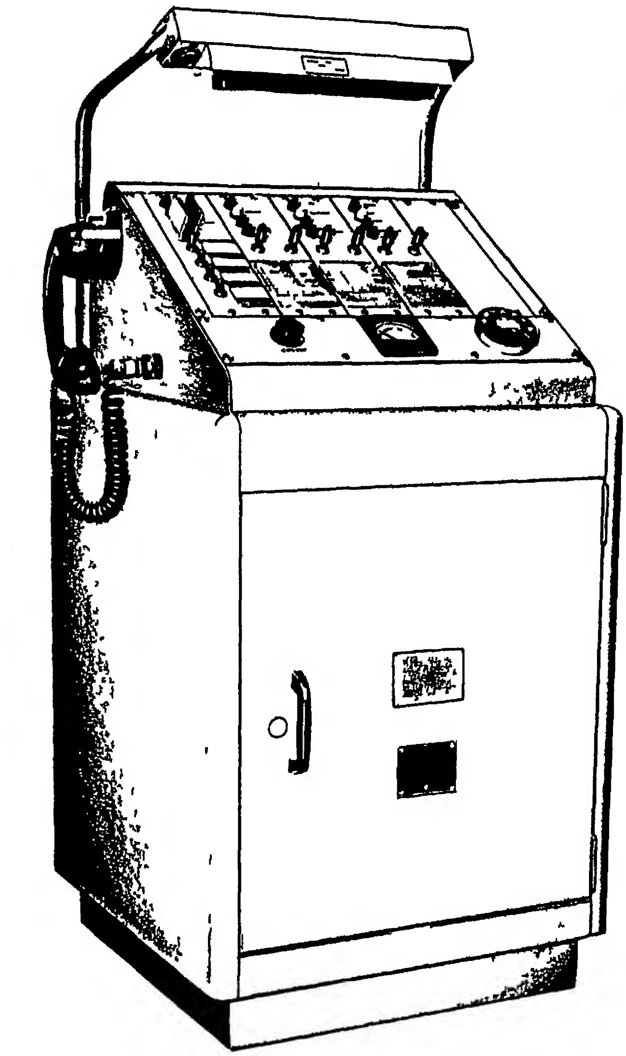
2. Establish voice communications between the console and the remote location.

3. Provide manual control of TACAN, VOR, and UHF Homer transmitters, using the telephone dial.

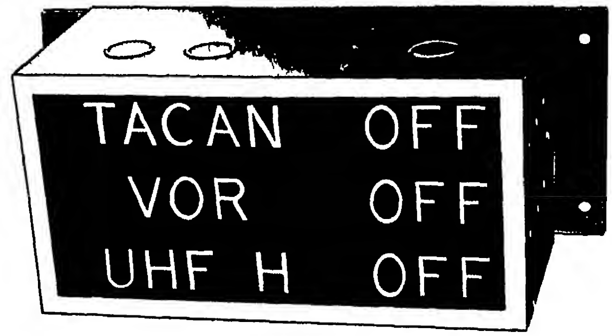
4. Provide a visual and an aural alarm should failure occur at the transmitter location.

5. Voice modulate the VOR and UHF Homer transmitters.

6. Shut down or restore to operation any, or all, of the transmitters at the transmitter locations.



201.35
Figure 10-23.—AN/GSA-35 air traffic control console.



201.36
Figure 10-24.—Remote navaid status indicator.

The control panel on the AN/GSA-35 is divided into four modular subpanels. Three of the subpanels contain the necessary switches and lamps to control and monitor a particular NAVAID transmitter. The subpanel on the left of the console is a dial control panel which is used in conjunction with the other subpanels to perform the required functions.

Where an indication of NAVAID status is required at positions other than the location of the main console, a remote indicator illustrated in figure 10-24 may be installed to provide a slave indication from the main console. The NAVAID descriptions on the left side of the remote indicator are lighted continuously, and the adjacent OFF is lighted when that particular NAVAID goes off the air.

It should be noted here that the GSA-35 is not the only NAVAID monitor used by the Navy. Newer equipment is being installed as it becomes available.

RUNWAY VISUAL RANGE (RVR) INDICATOR

The RVR (transmissometer) system works in conjunction with the operation of the runway lights and is normally set to operate when the tower operator selects step three, four, or five on the runway brightness control panel. RVR is an instrumentally derived value that represents the horizontal distance a pilot will see down the runway from the approach end. RVR may be used by you in lieu of the reported visibility by the observer, in the approval of straight-in instrument approach procedures, and takeoff minimums.

Theory of Operation

The transmissometer AN/GMQ-10 provides data for the computation of Runway Visual Range (RVR). The transmissometer supplies light transmittance signals in the form of pulse rates. These pulse rates are transmitted to the RVR converter where they are correlated with the obtained RVR data. The corresponding RVR

value is then displayed by the RVR display once every minute.

The system is designed to convert the transmittance pulse rates to their corresponding RVR values with a high degree of accuracy. They are based on a 500-foot baseline between the transmissometer projector and receiver.

The RVR values are displayed digitally (see figure 10-25) in increments of 200 feet ranging from 1,000 to 6,000 feet. Values less than 1,000 and greater than 6,000 feet are displayed as 800 feet and 6,200 feet, respectively. Actually, the RVR values are displayed as two-digit numbers which should be multiplied by a factor of 100 in order to obtain the correct reading. When the equipment is tested or the runway lights are OFF, the red light indicator on the display panel is ON. Consequently, the displayed values should not be accepted as true values of RVR.

Digital Display Indicator

The Digital Display Indicator can be rack-mounted or placed on a desk top for convenience of the observer. It is also completely enclosed for protection against foreign objects. All controls are located on the front panel. Interconnection of the converter and display is made in the rear. The front panel controls are shown in figure 10-25 and perform the following functions:

1. ON-OFF-TEST switch. Applies a.c. power to unit in TEST position or in ON position when RVR Converter is turned on.

2. TEST or RUNWAY LIGHTS OFF Indicator. Illuminated indicator informs operator that equipment is either in a test condition or that no RVR curve for runway lighting has been selected.

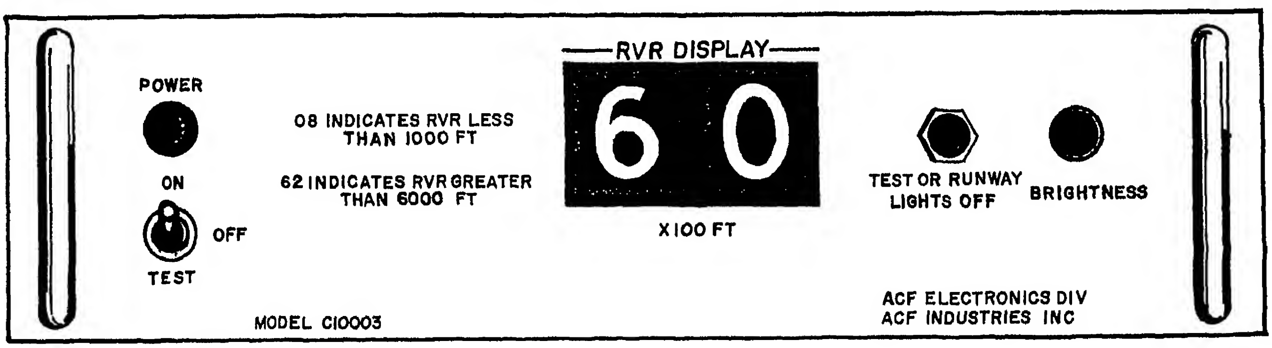
3. BRIGHTNESS control. Adjusts the brightness of the RVR display.

Make sure that all cables are connected properly. Turn the BRIGHTNESS knob fully clockwise. The display screen should now be illuminated. The observer should wait two minutes before observing the displayed digits.

TOWER BRITE RADAR DISPLAY

The Bright RADAR Indicator-Tower Equipment, Model 2, is commonly referred to as BRITE-2, a term derived from the initial letters of the nomenclature and the model number. The BRITE-2 system was designed for use in control towers by the local controller. (See figure 10-26.) The volume of traffic in the terminal area has increased to the point where it has become difficult to rely only on visual control of traffic in the vicinity of major airports. Factors which serve as a basis for this problem and contribute directly to the requirement are varying visibility conditions, a wide range of approach speeds, and larger airport landing areas.

As a tower controller, you have the responsibility of accurately sequencing arriving traffic and providing spacing between departures and



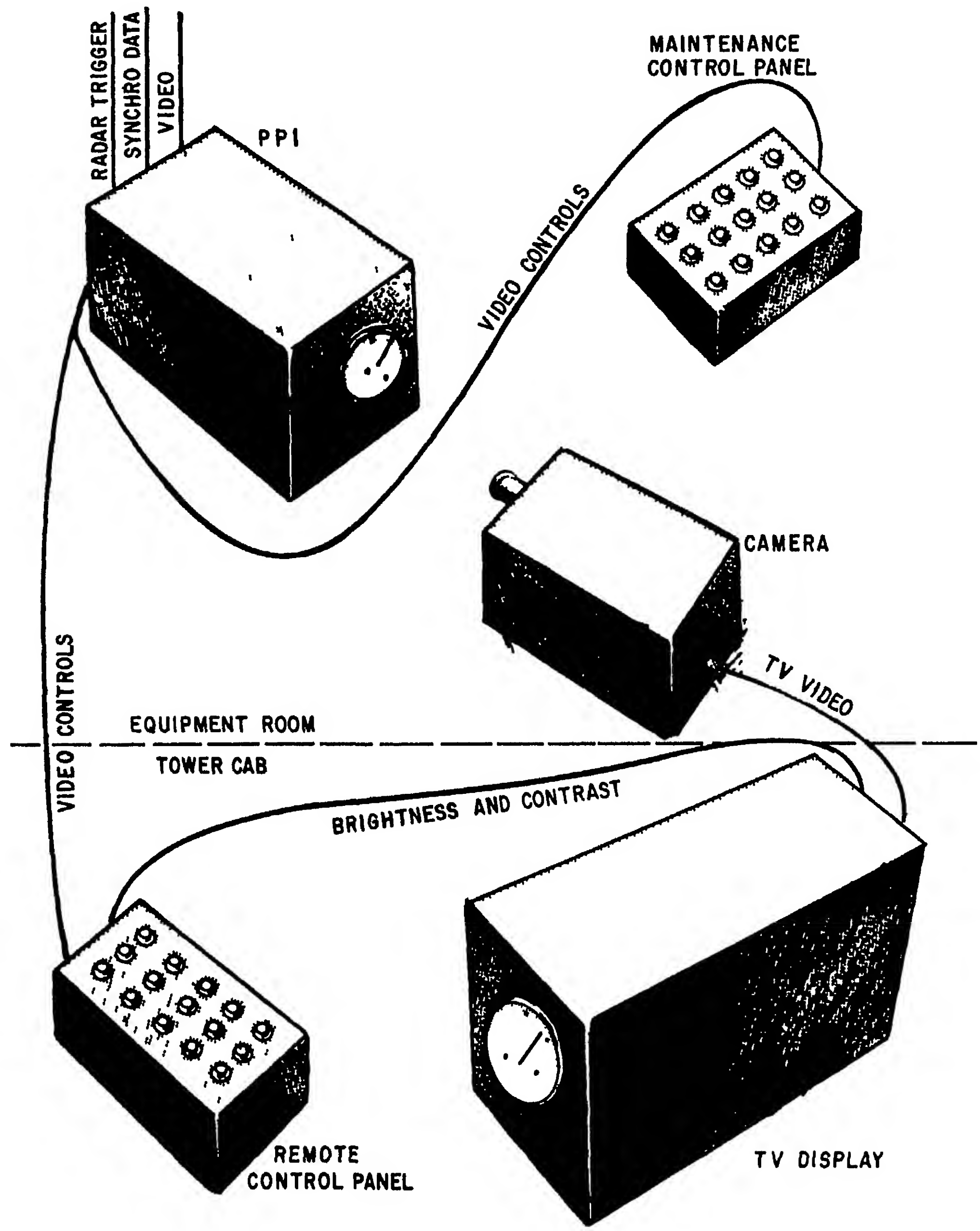
201.37

Figure 10-25.—Runway visual range indicator.

201.223

Figure 10-26.—BRITE Radar Indicator.

arrivals. In order to expedite traffic, you must take full advantage of minimum separation and at the same time maintain a proper margin of safety. The BRITE-2 system was developed to help you overcome this situation. When properly used, it reduces sequencing and traffic flow problems by extending your sight through the use of radar. It gives you an earlier, more accurate look at developing traffic situations. By providing you with the exact location of your traffic,



201.224

Figure 10-27.—Isometric view of BRITE.

BRITE-2 enables you to sequence traffic more accurately than was ever possible before.

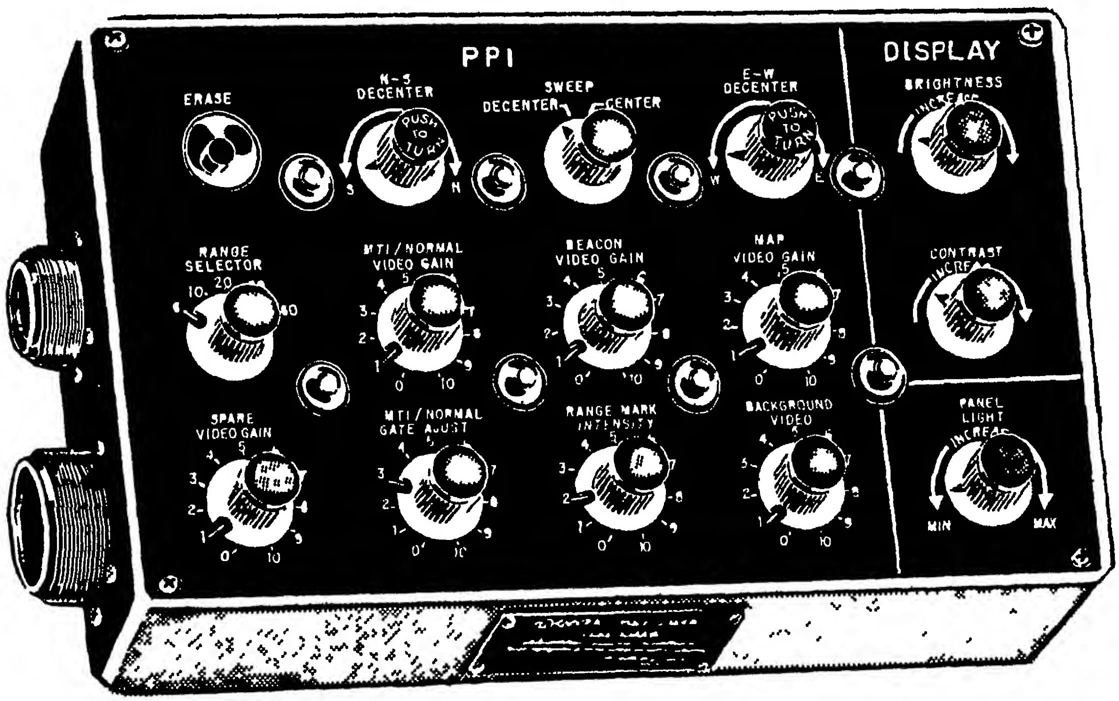
Basic Principles of Operation

Refer to figure 10-27 for the following discussion.

The BRITE-2 system provides a televised radar display at the local control position which may be viewed under the various light conditions found in a tower cab. It is composed of five basic components which include the TV display unit and the remote control panel located in the tower cab—also, the planned position indicator (PPI), TV camera, and maintenance control panel located in the equipment room. The PPI receives radar information from the airport surveillance radar and presents it on a 5-inch scope. The presentation is similar to that seen on an ASR indicator. The TV camera, which is focused on the face of the 5-inch scope, converts the optical image to a TV video signal. This signal is then transmitted via coaxial cable to the TV display unit in the tower cab.

TV Display Unit

The front of the TV display as shown in figure 10-26 contains the CRT bezel, power ON-OFF switch, FOCUS, BRIGHTNESS, and CONTRAST controls. The rear of the unit contains a switch for local or remote operation, two indicating fuses, and maintenance related connectors. The LOCAL-REMOTE switch on the back of the display unit affects the BRIGHTNESS and CONTRAST controls only. This switch, in the LOCAL position, enables the operator to make adjustments in the brightness and/or contrast levels using the control knobs on the front of the TV display unit. When the switch is placed in the REMOTE position, the adjustments must be made from the operator's remote control panel. (See figure 10-28.)



201.225

Figure 10-28.—BRITE remote control panel.

The FOCUS control feature also located on the front of the TV display unit cannot be "remoted" to any other location. It can alter the definition of the image being displayed but not beyond that which is established on the PPI and TV camera in the equipment room. Controllers should make no attempt to make focus adjustments since this is a maintenance function.

Remote Control Panel

The remote control is designed to be operated either on a desk top or recessed in a control console. (See figure 10-28.) The control panel is an edge-lighted plastic panel consisting of a black surface engraved in translucent white letters which are illuminated for night viewing from eight removable recessed panel lamps. Light is transmitted from the panel lamps at the edges of the plastic surrounding the lamps throughout the body of the plastic and to the edges of the engraved lettering. A panel light control is provided to vary the intensity of the illumination of the lettering.

Operating Instructions

The operation of the BRITE system is limited to the operation of the remote control panel as shown in figure 10-28. Perform the following procedural steps for the operation of the BRITE system:

1. Adjust display BRIGHTNESS control until the raster (horizontal pattern of scanning lines) is just visible on the cathode ray tube (CRT).
2. Adjust CONTRAST control until noise is visible on the CRT.
3. Set RANGE SELECTOR switch to the desired range as follows:

RANGE SCALES	RANGE MARKS
6 NM range	2 NM range marks
10 NM range	2 NM range marks
20 NM range	5 NM range marks
30 NM range	5 NM range marks
60 NM range	5 NM range marks

4. Adjust RANGE MARK INTENSITY control until the range marks are just visible, or at the desired level.
5. Adjust MAP VIDEO GAIN control until the video map is just visible, or at the desired level.
6. Adjust Moving Target Indicator (MTI)/NORMAL GATE ADJUST control fully clockwise.
7. Adjust MTI/NORMAL VIDEO GAIN control until target appears and is stored on the display for the desired time.
8. Adjust BACKGROUND VIDEO control until the amount of normal video superimposed on the MTI presentation is the desired level for a background signal.
9. Repeat process in step 7 to adjust BEACON VIDEO GAIN. Also applicable to SPARE VIDEO GAIN control if this channel is in use.
10. Set DECENTER-CENTER switch to DECENTER if an off-centered display is desired.
11. Depress and adjust the N-S and/or E-W DECENTER controls to move the sweep origin to the desired location.
12. Depress ERASE button to clear display of undesired target trail information.
13. Adjust panel light to desired level.

BASIC USE OF BRITE

When the BRITE-2 system is used, it supplements visual reference by correlating radar targets to visually observed aircraft or known reported pilot position and as an aid in sequencing aircraft. Radar traffic advisories may be provided to an aircraft under tower control. When used in conjunction with the control tower/radar visual communications (VISCOM) system, the BRITE gives the local controller a quick check of radar traffic at the time coordination is effected. Under these conditions, the control tower operators (CTO) rating includes as minimum: radar traffic information, procedures for primary and secondary radar identifications, and alignment procedure for the BRITE. In addition to services listed, the use of BRITE may be expanded to include radar separation and vectoring. As radar services are increased, tower personnel will be qualified in the use of applicable radar procedures. During IFR conditions, the

BRITE may be used to ensure that radar separation is sustained between IFR departures and IFR arrivals, successive IFR departures, and, at certain locations, for successive arrivals inside the final approach fix. Vectoring will always be limited to that which is required to separate aircraft. During VFR conditions, the most advantageous combination of visual and radar procedures are used.

VISUAL COMMUNICATIONS (VISCOM)

VISCOM is installed in many Navy control towers. It is a coordination device between the radar final controller and the tower local controller. VISCOM provides a service of lights and switches which supplements other circuits on the interphone system and serves to reduce the number of voice contacts between tower and radar controller. VISCOM systems may vary throughout the Navy; however, they all provide similar information and basic operation limitations. As the Navy updates its tower equipment, it is installing the AN/FSA-57 VISCOM system. The following description shows how VISCOM can be used at a typical radar/tower facility. Keep in mind that your facility may have different procedures and that the system does not replace all voice coordination.

The light circuits have four different colors of light. Each light is used to show the progress of radar's traffic. The purpose of each light is as follows:

1. White—this light indicates that an aircraft has entered the ATC system and is receiving radar service, or is on downwind, base leg, or is 15 miles out on a straight-in approach. The radar controller advises the tower of radio and radar contact by activating the white light switch, causing it to flash in both facilities, and furnishes the tower with the aircraft's identification, type, position, and type of approach. The tower controller acknowledges by depressing the white light switch, causing the light to become steady in both facilities.

2. Amber—this light indicates that the aircraft has reached a point 6 miles from touchdown or end of the runway, and clearance is requested to 3 miles. The radar controller activates an amber light switch, causing the white light to be canceled and the amber light to flash in both facilities. The tower controller clears the aircraft to 3 miles by activating the amber light switch, causing the light to become steady in both facilities.

3. Green—this light indicates that the aircraft is approaching 3 miles from touchdown or end of runway, and clearance is requested for landing, touch-and-go, or low approach, as applicable. The radar controller activates the green light switch, causing the amber light to be canceled and the green light to flash in both facilities, and verbally states the aircraft's range. The tower controller clears the aircraft by activating the green light switch, causing the light to become steady in both facilities. In addition to steadying the green light, the tower controller may issue a verbal clearance prior to the aircraft reaching the 3-mile point. The clearance includes field conditions and any altitude restriction to a low approach, if necessary. If this clearance is not received by 2 miles, the approach must be discontinued by the radar controller.

4. Red—this light indicates that the aircraft is to discontinue approach to the runway. The tower controller activates the red light by depressing the button, causing the light to flash in both facilities, and furnishes the reason for denying or canceling the clearance. After the radar controller has taken the necessary action to discontinue the approach, he steadies the red light. In most facilities, the red light switch also activates a buzzer or bell alarm which can only be turned off when the radar controller depresses a button at his console.

GENERAL EQUIPMENT

In addition to the equipments we have discussed, each Navy control tower is provided the following equipment as needed to meet operational requirements.

1. Weather vision or other display device used to update weather conditions.
2. Emergency communications equipment such as the crash alarm system discussed earlier in chapter 8.

3. Binoculars (at least one pair of 7 × 50 power or stronger).
4. Airfield lighting and visual landing aids controls.
5. Counters for recording the number of aircraft operations.
6. Wave-off (wheels up) lights control.
7. An airfield diagram and status board which should include the following information:
   a. Runways with length and width.
   b. Taxiways with direction indicated if not bidirectional.
   c. Intersection takeoff information.
   d. Arresting gear location and type.
   e. Location of navigational aids.
   f. Visual landing aids.
   g. Radar equipment status.
   h. NAVAID status (unless NAVAID monitors are located in the control tower).
   i. Arresting gear status.
   j. NOTAMs and non-NOTAM field conditions.
   k. Status of communications equipment.
   l. Outages of power.
   m. Weather warnings.
   n. Other pertinent information.

OPERATING MAINTENANCE

The air traffic control tower is a primary link in the air control system. Peak efficiency can only be maintained by ensuring that all electric and electronic equipment is functioning at all times. Outages of power and malfunction of equipment happen from time to time. Equipment performance checks and constant visual inspections of the tower equipments are necessary.

A good practice to follow is for each section, as it relieves the watch, to use some form of checkoff list. These checkoff lists should be completed as soon as possible (traffic conditions permitting) after going on watch. The list can be expanded or shortened as conditions warrant at any locality. Any malfunction should be immediately brought to the attention of the electronics technicians normally assigned to the tower. Under no circumstances should a tower operator tamper with the adjustments, repair, or maintenance of the control tower equipment.

Another good practice to follow is to make periodic visual inspections of all the tower equipment. This can be accomplished during periods when traffic is light, and can be done in a matter of minutes. Any control tower equipment out of adjustment or otherwise inoperative creates hardships for yourself and your shipmates.

The maintenance, general appearance, and condition of the tower and equipment, including furniture and cleanliness of spaces, reflect directly upon the attitude and spirit of the personnel assigned. Generally, everyone has an area of responsibility under the watch supervisor or section leader. As with any task you are assigned, your actions and attitude toward menial tasks are making impressions on your senior petty officers, and willingness to cooperate and do a good job does not go unnoticed. Most towers require that certain cleaning functions must be completed prior to the change of watches; while details such as window washing are performed less frequently. Remember that towers are filled with valuable electrical and electronic equipment that must be kept clean and free of dust to perform at peak efficiency.

EXERCISE

10-1. When a transmitter is selected on the AN/FSA 52, what color light glows above the frequency control switch?

10-2. The AN/FSA 52 controller's console may be programmed for how many (a) radio transmitters/receivers and (b) intercommunications positions?

10-3. What four modules normally are installed with the AN/FSA 58 controller's position?

10-4. With the AN/FSA 58, what is indicated by a steady, dim, green light when the XMTR SEL button is depressed?

10-5. How many (a) radiophone and (b) landline circuits may be programmed into an AN/FSA 58 controller's position?

10-6. List three uses for the voice recorders/reproducers used in air traffic control facilities.

10-7. How many channels may be simultaneously recorded on the AN/RD 379(V) voice recorder reproducer?

10-8. As a controller, what action in addition to notifying maintenance personnel must you take when recording equipment fails?

10-9. The wind indicator used in control towers measures direction in relation to magnetic North. When the direction or speed EXCEEDS plus or minus how many degrees/knots, you must (a) notify maintenance personnel, (b) consider it inoperative?

10-10. What action, if any, should you take if the official reported weather service altimeter is 29.92 and the instrument in the tower reads 29.93?

10-11. Assume that you are working the ground control position in the tower and an aircraft desires to cross a runway. Since you do not have any radio contact with the pilot, it is necessary to give a light-gun signal. You want to approve the crossing, but at the same time advise the pilot to be alert and cautious. Describe the signal you would give.

10-12. If, in the above instance you wanted the pilot to move out of the way because an aircraft was about to turn off the runway onto that taxiway, what light signal would you give?

10-13. What are the normal day/night ranges of the traffic control light?

10-14. In accordance with OPNAVINST 3721.1, when may a Navy controller use the traffic control light to clear a vehicle to cross a runway?

10-15. Briefly explain the function of the AN/GSA-35 console?

10-16. Fill in the blanks. To obtain an actual value when RVR equipment is operated, the reading in the window must be multiplied by ________. For example, a reading of 16 would indicate RVR value of ________ feet.

10-17. What are the five basic components of the BRITE-2 system?

10-18. How may the BRITE-2 system be used by a tower controller?

In each of the following instances, what do the typical VISCOM light coordination signals indicate?

10-19. A flashing white light to a tower local controller.

10-20. A flashing amber light to a tower local controller.

10-21. A steady green light to either a local controller or radar final controller.

10-22. A flashing red light to a radar final controller.

CONTROL TOWER

Learning Objective: **Recognize the responsibilities of control tower personnel.**

COMBINED RESPONSIBILITIES

Both controllers and pilots are responsible to each other for good communications, coordination, and cooperation. These three factors are not separate entities but must be considered as different parts of responsibility which are shared by pilots and air traffic control personnel. Some of these responsibilities are set forth in publications, while others are not delineated as a regulation or a rule but are recognizable as definite responsibilities of a controller since the ATC profession is one of service—that of aiding the pilot to accomplish a safe flight.

AUTHORIZED CONTROLLERS

Only those naval personnel properly qualified in accordance with OPNAV Instruction 3721.1 (Series) can exercise the control of air traffic. Tower controllers, to be considered fully qualified, must possess a Facility Rating for the airport to which they are assigned and an FAA CTO certificate.

NOTE: Certification requirements for control tower operators are detailed in FAR, Part 65, and chapter 2 of this manual.

TOWER OPERATING POSITIONS AND RESPONSIBILITIES

Establishment of controller positions varies according to local requirements and type of facility, but those included in most control towers are Local Control position, Ground Control position, and Approach Control position.

The primary duties of the tower supervisor are to direct activities of a tower under the general supervision of the leading chief and/or watch officer. The tower supervisor supervises all positions of operation and directs the training of new personnel.

The key facility of the airport operational system is the control tower. It is elevated to a suitable height to afford the maximum visibility of the airport and the immediate area. The primary objective of the control tower is to promote the safe, orderly, and expeditious movement of air traffic. This includes the following:

1. Aiding pilots in preventing collisions between aircraft and between obstructions and aircraft in the movement area.
2. Expediting and maintaining an orderly flow of air traffic.
3. Assisting the person in command of an aircraft by providing such advice as may be necessary for the safe and efficient conduct of a flight.
4. Notifying appropriate organizations regarding aircraft known or believed to be in need of search and rescue aid, and assisting such organizations as required.

The control tower exercises control of all aircraft operating on and around an airfield; all movements of aircraft must have prior approval from the Control Tower. This includes instructions and permission to tow, taxi, takeoff, land, and related aircraft operations (except where preventive control has been authorized).

NOTE: Preventive control differs from other airport traffic control in that repetitious, routine approval of pilot action is eliminated. Controllers intervene only when they observe a traffic conflict developing.

The following operating positions and their responsibilities may be found in Navy control

towers. Operating positions may be added, deleted, combined, or integrated as necessary to meet local requirements.

Approach Controller (AP)

The approach controller is responsible for the coordination and control of instrument traffic within the ATC facility area of jurisdiction. Primary duties of the approach controller include the following:

1. Issuing ATC clearances and advisory information to aircraft under approach control jurisdiction.
2. Determining the separation and sequence to be used between aircraft.
3. Providing assistance and priority of services to aircraft in emergency situations.
4. Utilizing any or all other operating positions as necessary.

NOTE: At an ATC facility providing radar approach control services, the approach control position is located in the control room normally designated as the "IFR room."

Local Controller (LC)

The Local Controller is responsible for maintaining a continuous radar and/or visual surveillance of the airport traffic area and other movement areas. Primary duties of the Local Controller include the following:

1. Formulating and issuing clearances and control instructions to accomplish separation between aircraft and between aircraft and vehicles operating under the jurisdiction of the tower.
2. Effecting coordination with appropriate operator positions and other facilities.
3. Providing flight assistance service to aircraft.
4. Operating airport lighting, lighting systems, and visual landing aids.
5. Initial notification and dispatch of emergency personnel and equipment for aircraft emergencies and accidents.

Ground Controller (GC)

The Ground Controller is responsible for exercising general surveillance of the airport movement area. Primary duties of the ground controller include the following:

1. Formulating and issuing ground movement clearances to aircraft and vehicles operating on the airport.
2. Transmitting current weather and field conditions as required.

Flight Data Position (FD)

The duties of the flight data position are:

1. Operating interphones/telephones and communications equipment, as required.
2. Posting, relaying, and coordinating aircraft movement data.
3. Monitoring navigational aid alarm systems.
4. Operating Automatic Terminal Information Service (ATIS).

Clearance Delivery (CD)

The duties of the clearance delivery position are:

1. Obtaining, posting, and relaying ATC clearances and advisories.
2. Other duties as assigned by the Tower Supervisor.

CONTROL TOWER LOGS

This record or log is kept from watch to watch in all Navy Control towers. It contains all of the pertinent data accumulated during each watch performed in the control tower. A partial listing of the data that is entered indicates status of equipment, check of communications, status of airport lighting facilities, runway or runways in use, and any other information deemed necessary by the control tower officer, chief, or section leader of the tower concerned. The items listed above are not standard throughout the Navy, but they serve to indicate certain items which should be contained in the control tower log.

At many facilities it is an accepted practice to make an entry in the tower log of the weather when the watch is changed and at anytime the field goes from VFR to IFR weather conditions or vice versa.

Additionally, many facilities log entries of emergencies and crashes in the tower log in red ink. All details of such incidents with the associated time of occurrence are included for later reference.

A position log is also maintained for each operating position in the tower. The purpose of this log is to ensure a formal turnover as the watch or position is being turned over to another controller, and to establish a reliable record of position manning. These logs must contain the following:

1. Date.
2. Time.
3. Position.
4. Controller operating initials. (If the position is operated by a trainee, the trainee's initials shall be entered after those of the controller responsible for the position.)

DAILY AND MONTHLY TRAFFIC TABULATION

To facilitate completion of certain reports required of the ATC Division, a daily and monthly tabulation of aircraft operations is necessary. One system commonly used is posting flight progress strips on each operation. At midnight a traffic count is made from the strips, and subsequently a monthly count is made. These strips are kept for 3 months before they are destroyed. If any strip contains information on an aircraft involved in an accident or emergency, it is kept for a longer period of time.

This same basic procedure may also be employed by personnel assigned to the planning/approval branch and at the approach control position; however, different data is required in these areas.

In addition to the previously described data, radar facilities are required to maintain a record of all radar approaches conducted by both military and civil aircraft, under IFR and VFR conditions.

A compilation of all operations is submitted semiannually to the Chief of Naval Operations with a copy sent to the Federal Aviation Administration.

This report is referred to as the Air Traffic Activity Report (OPNAV Form 3721/12). Instructions for completing this report are contained in the ATC Facilities Manual, OPNAVINST 3721.1 (Series).

EXERCISE

In answering exercises 10-23 through 10-26, select from column B the tower operating position responsible for each of the functions listed in column A.

Column A	Column B
10-23. Separation of IFR traffic	a. FD
10-24. Control of VFR traffic	b. AP
10-25. Handling taxiing aircraft	c. GC
10-26. Operating ATIS	d. LC

GENERAL CONTROL TOWER PROCEDURES

Learning Objective: **Identify some of the general procedures applicable to control tower operations.**

As an air traffic controller, you should provide air traffic control service based only upon observed or known traffic and airport conditions which might, in your judgement, constitute a hazard. These include parachutists within the control zone, vehicular traffic, large flocks of birds in the vicinity of the airport, and temporary obstructions on or near the airport.

ADVISORY INFORMATION

Specific approval or disapproval for movement of vehicles, equipment, or personnel on the movement area is issued via radio or directional light gun. Approval of specific situations should not be qualified by conditional phrases such as BEHIND LANDING TRAFFIC, or AFTER THE DEPARTING AIRCRAFT.

A clearance for takeoff, to land, or to make touch-and-go can be denied only on the basis of traffic conditions, except in the case of a closed runway or below minimum visibility conditions. Clearance for a low approach can be denied only on the basis of traffic conditions.

Should a pilot request to use a closed runway, inform the pilot of the fact that the runway is closed and, if necessary, the appropriate parts of the NOTAM applying to the runway should be quoted.

When you relay any message to an aircraft, you should include the source of the message.

EXAMPLE: OPERATIONS OFFICER ADVISES, or SQUADRON DUTY OFFICER REQUESTS (message).

If you should observe an abnormal condition of an aircraft, the pilot of the aircraft should be informed.

EXAMPLE: REAR BAGGAGE DOOR APPEARS OPEN.

If a pilot is not sure that the landing gear is down and locked, the pilot must notify the control tower. You then instruct the pilot to perform a low pass in front of the tower for the purpose of a visual check, then relay to the pilot the results of the visual check.

EXAMPLE: LANDING GEAR APPEARS DOWN AND IN PLACE; or, NOSE GEAR DOES NOT APPEAR IN PLACE.

Should any doubt exist after a visual check, alert the crash and rescue equipment and the aircraft pilot. The pilot should then make a precautionary landing. After the landing rollout, the aircraft should not be turned off the runway until ground personnel have made a visual check of the landing gear and installed the gear pins.

Unusual maneuvers of an aircraft within an airport traffic control area should not be approved or requested if such maneuvers are not essential to the performance of the flight.

FIELD INFORMATION

Issue pertinent field condition information necessary for an aircraft's safe operation in time for it to be useful to the pilot. The following information concerning field conditions must be issued to any pilots concerned:

1. Construction work on or immediately adjacent to the movement area.
2. Rough portions of the movement or landing area.
3. Braking conditions caused by ice, snow, slush, or water.
4. Snowdrifts or piles of snow on or along the edges of the area; also the extent of any plowed area.
5. Parked aircraft on the movement area.
6. Irregular operation of part or all of the field lighting system.
7. Any other field conditions considered pertinent by the controller.

Description of field conditions issued should be stated clearly and concisely.

EXAMPLES: MOWER TO LEFT OF RUNWAY; or WORKMEN ON TAXIWAY

WEATHER INFORMATION

You may transmit to pilots or other ATC facilities, without consulting weather service personnel, any elements of weather information derived directly from instruments, from radar, or received as a pilot report. Observed weather conditions such as LARGE BREAKS IN THE OVERCAST, VISIBILITY LOWERING TO THE SOUTH, or similar statements which do not include specific values may also be transmitted. Terminal radar control facilities should inform

towers for which they provide approach control service about storm areas observed on radar.

Elements of weather information which include specific values (such as ceilings and visibility) may not be transmitted unless you are properly certificated and acting as a weather observer, or the weather observation was made or verified by weather service personnel.

You should inform local weather service personnel of any differences between weather conditions observed from the tower and those reported by weather service.

BIRD ACTIVITY INFORMATION

Bird activity information including position, size, and species (if known), and their course of flight should be issued to pilots of aircraft concerned for at least 15 minutes after receipt of the information from pilots or adjacent facilities. This time may be reduced when either visual observations or subsequent reports reveal that the activity is no longer a factor.

RUNWAY USE

Except where a "runway use" program is in effect, select the runway to use, or the duty runway, as follows:

1. The runway most nearly aligned with the wind, when the wind velocity is 5 knots or more.
2. The calm wind runway, when the wind velocity is less than 5 knots.

Use of a runway other than those mentioned above is permissible if it will be operationally advantageous or if it is requested by a pilot. If a pilot prefers to use a runway different from that specified by a controller, he is expected to advise the controller accordingly.

Runway use programs for large aircraft and turbojet aircraft may be established at some airports. Where such programs are established, runway assignment is affected by consideration of noise sensitive areas and noise abatement benefits. Acceptance or refusal of such assignments is still the pilot's prerogative.

You must issue both wind direction and velocity when authorizing the use of runways, even though the wind velocity is less than 5 knots and the calm wind runway is to be used. This information is necessary since some aircraft are adversely affected by a tailwind or crosswind component, and pilots must be aware of the exact wind condition to make the decisions necessary for a safe flight. Therefore, the wind condition is described as "calm" only when the velocity is less than 3 knots.

RUNWAY CONDITIONS

At those facilities affected by winter weather conditions, runway condition and braking action are important information which you must relay to pilots when adverse conditions exist on the landing area.

Detailed procedures for the determination and reporting of runway surface conditions in terms of runway condition reading (RCR) are contained in chapter 4 of this manual.

NOTE: The final approach, touchdown, landing roll, takeoff, and initial climb to the first turn away from the airfield are considered to be the most critical phases of flight—phases requiring the full attention of the pilot. Except during radar approaches or departures, controllers shall refrain from transmitting to the aircraft during these phases of the operation unless conditions affecting safety of flight are observed or are known to exist. Safety of flight considerations, including airfield conditions, shall be transmitted at any time observed by, or made known to the controller.

PARKING TRANSIENT AIRCRAFT

Pilots of arriving aircraft normally shift to ground control frequency upon clearing the duty runway. At this time the ground controller issues any additional instructions necessary for the aircraft to proceed to the appropriate destination on the field. Pilots of aircraft based aboard a particular station or those who are known to be familiar with the field may need only an acknowledgment from ground control that they are on ground control frequency and a brief instruction to complete the operation.

EXAMPLE: TAXI TO YOUR LINE.

Pilots who are unfamiliar with the field may need precise step-by-step instructions to get the aircraft to the proper place. Actual parking of the aircraft is accomplished by a line crew; however, the ground controller should provide the line crew with advance notification of the aircraft's arrival so that the transition from instructions issued by the tower to visual signals provided by the lineman is a smooth and continuous operation. Use of FOLLOW ME vehicles is common at many fields to simplify the procedure of getting an unfamiliar pilot to the parking area on the field as expeditiously as possible. The ground controller will have communications with both the FOLLOW ME vehicle operator and the aircraft, but communications normally do not exist between the vehicle and the aircraft. This requires liaison and coordination to get the vehicle in the proper pickup position and ensure that the pilot establishes visual contact with the vehicle. These vehicles are usually lighted for night use.

Refueling operations are outside the authority or responsibility of tower controllers; however, you may be called upon to relay advance information to the appropriate personnel about the type or grade of fuel required by a transient aircraft. This allows the refueling truck to be called out and meet such aircraft when they are parked, thereby expediting refueling and reducing ground time.

PRIORITY

Air traffic control service is provided on a first come, first serve basis as circumstances permit, with the following exceptions:

1. Maximum possible priority should be provided military air evacuation flights when requested by a particular pilot. Particular consideration to priority should be given in terminal areas and to avoid turbulent conditions.

2. Maximum assistance should be provided SAR aircraft while performing a SAR mission.

3. Special handling may be required to expedite a Semiautomatic Flight Inspection Aircraft (SAFI), which is a specially equipped aircraft with a preplanned system of checking certain navigation aids.

4. Special consideration must be given to expedite the movement of the Presidential or the Vice Presidential aircraft and any escort aircraft as well as related control messages when traffic conditions and communications facilities permit.

5. Expeditious handling is required for any aircraft using the code name FLYNET. This code name indicates that the aircraft is transporting a nuclear emergency team to the location of a nuclear incident.

Insofar as assigning priorities for the handling of aircraft experiencing emergencies is concerned, no set priorities can be prescribed because of the infinite variety of possible situations which may occur.

It should be remembered however, that aircraft in distress have the right of way over all other traffic.

All naval air activities may assign priorities to VIP traffic. Priority normally is not given to VIPs; however, all Navy air traffic control facilities may give consideration to VIPs as long as safety is not affected.

The operation of jet-propelled aircraft necessitates expeditious handling to avoid excessive fuel consumption during taxiing, takeoff, and landing operations. Therefore, the following instructions must be followed by naval control tower operators:

1. Jet aircraft must NOT be granted priority for taxiing, takeoffs, or landings unless the pilot so requests.

2. In granting priority: (1) Jet aircraft may be cleared first when propeller-driven aircraft will delay taxiing and takeoff; (2) if jet aircraft are ready for takeoff and propeller-driven aircraft are approaching for landing, jet aircraft may be cleared for takeoff and all other aircraft except jet, hospital evacuation, and aircraft in emergency may be instructed to circle the field; (3) jet aircraft approaching for landing may be cleared ahead of all other aircraft (both jet and conventional) taking off and ahead of all other aircraft landing except those in emergency and hospital evacuation aircraft.

Pilots of jet aircraft should not request priority except when considered necessary. Ordinarily, the necessity should not exist for flights in the local flying area.

EXERCISE

10-27. List four types of information that you should provide aircraft operating on or in the airport traffic area.

10-28. When may a "calm wind" runway be used as the duty runway?

10-29. What phases of flight are considered to be the most critical?

10-30. Normally, when will a landing aircraft switch to ground control frequency?

10-31. Normally, air traffic control services are provided on what basis?

ARRIVAL PROCEDURES

Learning Objective: **Identify the component parts of standard traffic patterns and state the landing and sequencing information given to pilots. State the minimum separation standards between arriving aircraft.**

TRAFFIC PATTERNS

Two types of traffic patterns are established at each airfield: (1) the rectangular or conventional pattern and (2) the overhead pattern. Normally traffic patterns provide for left traffic flows; however, right traffic flows are used when required and deemed necessary.

RECTANGULAR PATTERN

Figure 10-29 shows the various components of a standard traffic pattern. Under normal conditions, the flow of traffic is counterclockwise;

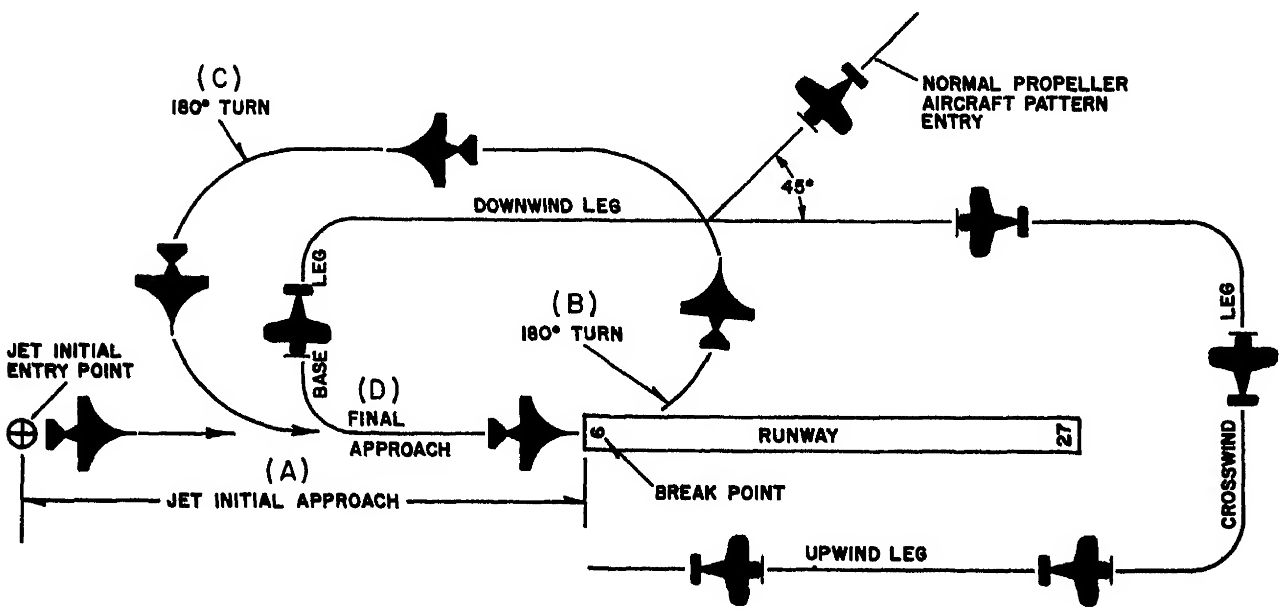


Figure 10-29.—Conventional and overhead approach traffic patterns.

the pilot makes left turns in the traffic pattern. The standard traffic pattern "legs" shown are (1) the upwind leg, a flightpath parallel to the landing runway and in the direction of landing; (2) the crosswind leg, a flightpath at right angles to the landing runway off its upwind leg; (3) the downwind leg, a flightpath parallel to the landing runway in the direction opposite to landing; (4) the base leg, a flightpath parallel at right angles to the landing runway off its approach end and extending from the downwind leg to the intersection of an imaginary extended runway centerline; and (5) final approach, a flightpath in the direction of landing along the imaginary extended runway centerline from the base leg to the runway. Naturally aircraft characteristics such as speed and maneuverability must be considered in issuing your control instruction. For instance, you know that a jet flies at a greater speed than a light, conventional-type aircraft in the traffic pattern and, therefore, might make wider turns and fly an expanded pattern. Your control instructions must be based on this knowledge in sequencing your traffic.

Traffic pattern altitudes for the rectangular pattern are established to be 1000 feet above the field elevation, to the nearest 100-foot level, or an optional 1500 feet when aircraft concerned create a noise disturbance. For example, if the field elevation is 245 feet and a 1000-foot-above-elevation pattern is desired, the pattern altitude would be established as being 1200 MSL.

Although all aircraft are capable of flying this type pattern, most high-performance aircraft prefer the overhead approach. Let's review this type pattern and its component parts.

OVERHEAD APPROACH PATTERN

Overhead approach patterns are ordinarily established at airports where military aircraft are assigned. The patterns are primarily designed so that high-performance aircraft, such as fighters and certain types of trainers, can be worked into the terminal area simultaneously with slower aircraft that are flying a rectangular pattern. The overhead approach, along with its components, is shown in figure 10-29.

The component parts of the overhead approach are:

a. The initial approach. This is a line of flight following the extended centerline of the runway toward the landing runway. It varies in length of from 3 to 5 miles. The aircraft's altitude at this point should be the established traffic pattern altitude, which is normally 1500 feet above the field elevation, or 2000 feet above field elevation if the base uses the optional 1500-foot rectangular traffic pattern. In all cases, it is 500 feet above the rectangular pattern altitude.

b. The break point. This is a point, normally just above the landing threshold, where the aircraft is turned (left or right, depending on the direction of traffic flow) 180° so as to be on downwind leg.

c. The base leg. After the downwind leg segment, a second 180° turn is made so as to establish the aircraft on final approach. Up until the time that the second 180° turn is started, the aircraft remains at the traffic pattern altitude.

d. The final approach. Regardless of the type of aircraft that you are controlling, or the type of approach the aircraft is executing, you should notice that all arriving aircraft must fly at least one common component of a standard traffic pattern—final approach.

NOTE: Rollout on final approach must not be less than one fourth of a mile from the runway end and not less than 300 feet above the ground.

LANDING INFORMATION

Normally, arriving aircraft make initial radio contact with the terminal control facility approximately 15 miles (5 minutes) from the airport. Although this procedure is not mandatory, nor always adhered to by all pilots, it has a definite advantage. In all cases, however, the pilot is required to make contact before he enters the control zone, traffic pattern (if he is on a local flight inside the control zone), or the airport traffic area if there is no control zone.

We refer to arriving aircraft as those aircraft that are airborne and are maneuvering to land at your station. Your primary objective in providing service to these aircraft is to ensure that a safe

and orderly flow of traffic is maintained. Provide landing information, as appropriate, to arriving aircraft when initial radio contact is established. You may omit items of information if they are contained in the ATIS broadcast and the arriving pilot states the correct ATIS code. Another procedure you may encounter which greatly reduces frequency congestion is the term "have numbers." In terminal areas where ATIS is not provided, a pilot may monitor the tower local frequency for a sufficient length of time prior to initial contact to determine routine landing or departure information. Upon making initial contact, the pilot will use the term "have numbers" or a similar phrase to indicate that he has received the wind, runway, and specific traffic pattern information. Upon hearing the pilot use this term or similar phrase, you may omit these items when issuing landing information.

Otherwise, issue landing information by specifying the following to arriving aircraft:

(1) Specific traffic pattern information such as: enter left base, enter right base, make straight-in, right traffic, make right traffic. This type of information may be omitted if the aircraft is to circle the airport to the left.

(2) Runway in use.

(3) Surface wind.

(4) Altimeter setting. This item may be omitted if the aircraft is vectored to the airport by approach control, since it will have already been issued it.

(5) Any supplementary information, such as the runway condition readings.

(6) Request for additional position reports. In the majority of cases, this report will be the point when and where the aircraft enters the traffic pattern.

(7) Ceiling and visibility if either is below basic VFR minimums.

(8) Clearance to land. Issue at the appropriate point in the traffic pattern. At this point, issue any field conditions necessary, such as construction work on or near the runway.

Issue the following additional landing information to aircraft that will conduct an overhead approach:

Traffic pattern altitude and direction of turns. You may omit either or both when they are standard or you know that the pilot is familiar with a nonstandard procedure.

A request for the pilot to report on initial approach.

If it is required for traffic reasons, request that the pilot report "Break." Specify the point of break if it is nonstandard or you desire to change the break point for traffic reasons.

Under normal conditions, after landing information has been issued, further communications are not required until the aircraft reports entering the traffic pattern. When the pilot reports entering the pattern, you provide what may be the most important information you will issue. At the very least, proper use of this next item is the key to effective terminal control.

Wheels-down Check

Remind pilots to check for wheels down on the aircraft at an appropriate position in the traffic pattern. The intent is solely to remind the pilot and does not place any responsibility on you. You may omit this reminder if the pilot reports the wheels down.

Visual Holding of VFR Aircraft

You may, from time to time, find it necessary to hold arriving VFR aircraft in order to adjust the flow of traffic. When this becomes necessary, clear the aircraft to hold at selected, prominent geographical fixes which are easily recognized from the air. If you have more than one aircraft holding at the same fix, issue traffic information.

SPACING AND SEQUENCING

Often, there are several aircraft in the traffic pattern at the same time. As the local controller, you are required to issue certain advisories relating to an arriving aircraft's landing sequence with respect to other aircraft ahead of it in your pattern.

Sequencing your traffic may be defined as assigning a number to an aircraft that signifies the numerical order in which the aircraft will be

landing. The number is determined by the number of preceding aircraft maneuvering to land on the same runway. Normally, such information is issued to the pilot concerned when the pilot reports entering your traffic pattern. When you are issuing a landing sequence to a pilot, there are several items which must be included in your advisory. These include the pilot's landing sequence number and a description and location of the aircraft to follow.

Establish the sequence of arriving aircraft by requiring them to adjust flight as necessary to achieve proper spacing. Some examples of phraseology used to accomplish this are: EXTEND DOWNWIND, MAKE SHORT APPROACH, CIRCLE THE AIRPORT, GO AROUND.

When an aircraft reports in the traffic pattern at a position where he should be seen but is not visually observed by you, what do you do? Well, you advise the pilot that he is "NOT IN SIGHT" and issue normal landing sequence number and other information as in routine matters.

Records indicate that an unusually large portion of midair or near-midair collisions occur during periods of good weather conditions when pilots are flying VFR and depending upon the see and be seen concept. Because of the limited dimension of airport control zones and the large number of aircraft confined within this relatively small airspace, you must be continually alert.

FIXED WING SEPARATION STANDARDS

Single aircraft rarely create a problem for the air traffic controller. In fact, most people, regardless of their profession, can determine when the runway is clear of traffic and an aircraft can land or take off. We are not telling you that you can be replaced by the average person off the street. As the volume of traffic increases in the pattern, so does the complexity of controlling that traffic.

The basic rules that you must follow when controlling air traffic are contained in FAA Handbook 7110.65. This handbook establishes procedures, separation standards, and phraseologies to be used. The separation minimums we will discuss in this chapter are those used by the controller in the tower.

Pilots flying in accordance with VFR are required to maintain their own separation from other aircraft; however, there are standards that you must observe when clearing aircraft for landing or takeoff. In using these standards you must never forget two important facts: (1) the separation rules are the MINIMUM distances by which aircraft must be separated, and (2) controllers give their services to pilots on a first-come, first-serve basis. Keeping this in mind, let us discuss the fixed-wing VFR separation standards.

NOTE: When applying the following separation standards, aircraft cleared for touch-and-go, stop-and-go, or low approach are considered to be an arrival up to one point, and thereafter, as a departure. A touch-and-go is an arriving aircraft until it touches down, and then it is a departure. A stop-and-go is an arrival until it comes to a full stop; a low approach until it crosses the landing threshold; thereafter they are considered to be departures.

You may authorize a low approach with an altitude restriction of not less than 500 feet above the airport. This procedure can be authorized over a preceding arrival, over equipment on the runway, or over personnel working on the runway—providing all personnel are advised that these operations are being conducted. The approaching aircraft must also be advised of the location of ground traffic, personnel, and equipment. However, never authorize a low approach over an aircraft in takeoff or departure position.

Basic Separation Minimums

The basic VFR separation standards which you must observe when clearing an aircraft to land are:

1. Separation between two arriving aircraft. Sufficient separation must exist between arriving aircraft so that the first aircraft has taxied off the runway before the second aircraft crosses the

landing threshold on its final glide. (See figure 10-30.)

2. Separation between an arriving aircraft and preceding departing aircraft. Sufficient separation must exist so that the departing aircraft has crossed the opposite end of the runway before the arriving aircraft crosses the landing threshold on its final glide. (See figure 10-31.)

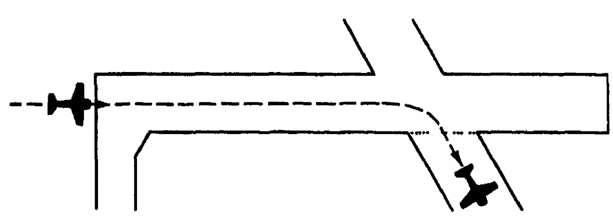
Special Minimums

Under certain conditions, categorizing aircraft allows the tower controller to select and apply reduced separation minima by using specified distances as determined by suitable landmarks, such as runway distance remaining markers. These reduced minima can be applied between successive arrivals, successive departures, and arrivals and departures using the same runway. However, for arriving aircraft, these reduced standards can be used only between sunrise and sunset. The categories are:

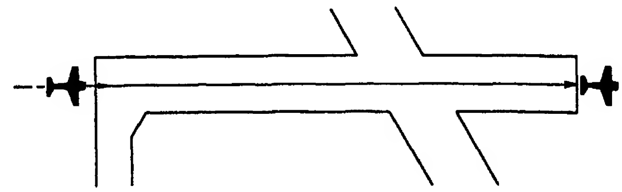
1. Category I—Light-weight, single-engine, personal type propeller-driven aircraft. This category does not include higher performance single-engine aircraft such as the T28.

2. Category II—Light-weight, twin-engine, propeller-driven aircraft weighing 12,500 pounds or less such as the U-11. This category does not include such aircraft as the DC-3 or C-131.

3. Category III—All other aircraft such as the higher performance single-engine, large



201.149
Figure 10-30.—Separation between arriving aircraft.



201.151
Figure 10-31.—Separation of arriving and preceding departing aircraft.

twin-engine, four-engine, and turbojet aircraft excluding aircraft capable of takeoff weights of 300,000 pounds or more.

NOTE: Aircraft capable of takeoff weights of 300,000 pounds or more, whether or not they are operating at this weight, are classified as HEAVY, and special wake turbulence separation minima and procedures apply. You should refer to the applicable chapters in FAA Handbook 7110.65 for these minima and procedures.

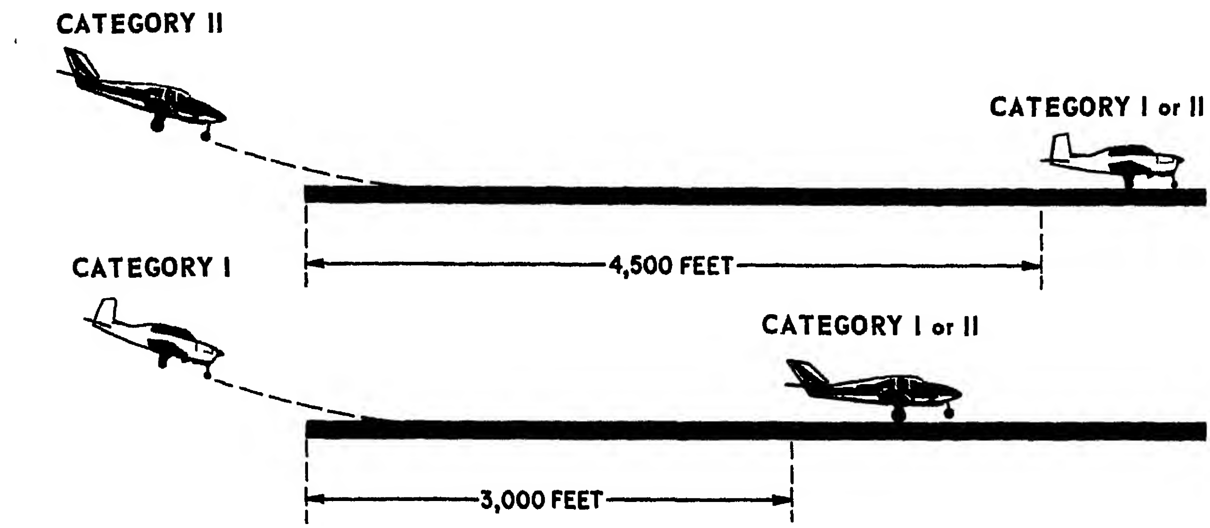
To apply these special minimums between two arriving aircraft, the runway need not be clear if the following minimum distance exists from the landing threshold:

1. When a category I aircraft is landing behind a category I or II aircraft, 3,000 feet may be used.

2. When a category II aircraft is landing behind a category I or II aircraft, 4,500 feet may be used. (See figure 10-32.)

You may also apply these special minimums between an arriving aircraft and a preceding departing aircraft using the same runway. If the departing aircraft is airborne, it need not have crossed the departure end of the runway if the following minimum distance from the landing threshold exists:

1. When a category I aircraft is landing behind a category I or II aircraft, 3,000 feet may be used.



201.150

Figure 10-32.—Separation of different category arriving aircraft.

2. When a category II is landing behind a category I or II aircraft, 4,500 feet may be used.

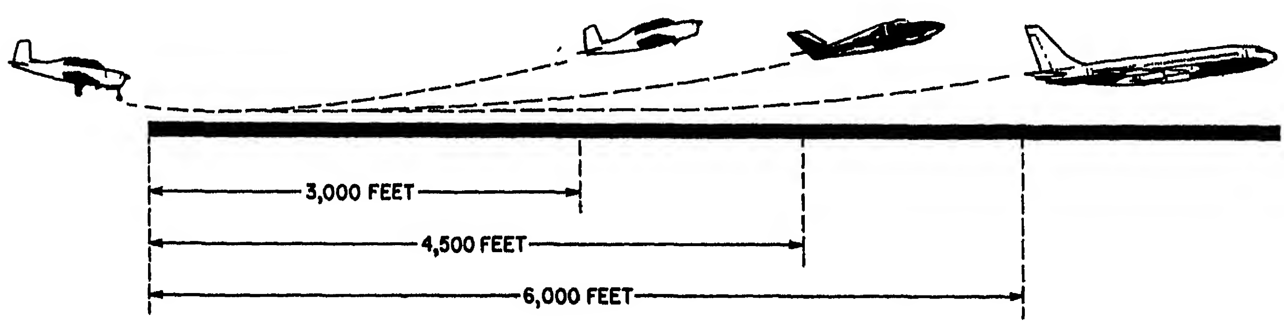
3. When either aircraft is category III, 6,000 feet must be used. (See figure 10-33.)

Intersecting Runways

Quite often, more than one runway is being used for arriving and departing traffic. When these runways or flight paths intersect, the preceding standards are not applicable and we have a new set of rules to use.

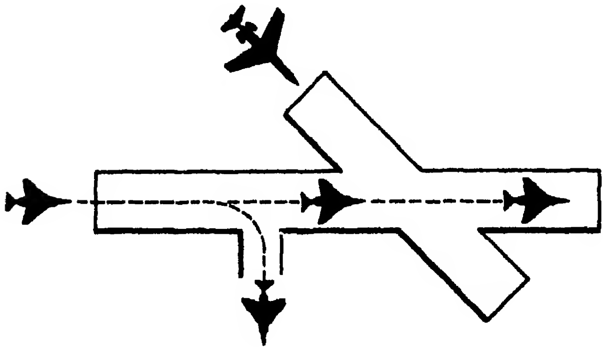
Separate an arriving aircraft using one runway from another aircraft using an intersecting runway or nonintersecting runway when the flight paths intersect, by ensuring that the arriving aircraft does not cross the landing threshold until one of the following conditions exists:

1. The preceding arriving aircraft has taxied off the landing runway, completed landing roll



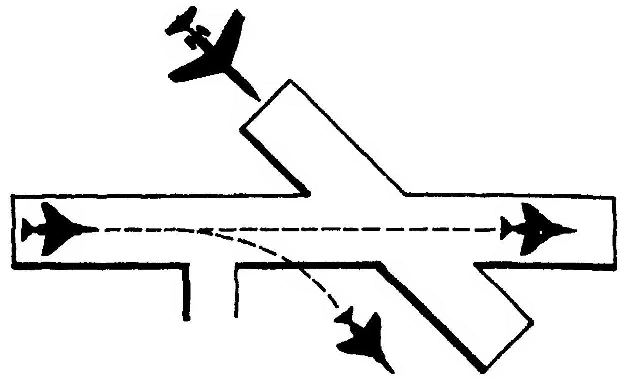
201.152

Figure 10-33.—Separation of arriving and preceding departing aircraft of different category.



201.148

Figure 10-34.—Separation of arriving and other arriving aircraft using intersecting runways.



201.147

Figure 10-36.—Separation of arriving and other departing aircraft using intersecting runways.

and will hold short of the intersecting runway/flight path, or has passed the intersection/flight path. (See figures 10-34 and 10-35.)

2. The preceding aircraft has departed and passed the intersection/flight path or is airborne and turning to avert any conflict. (See figures 10-36 and 10-37.)

Landing clearance to a succeeding aircraft need not be withheld if you observe the positions of the aircraft involved and determine that prescribed runway separation exists when the aircraft crosses the landing threshold. You must also issue traffic information to the succeeding aircraft.

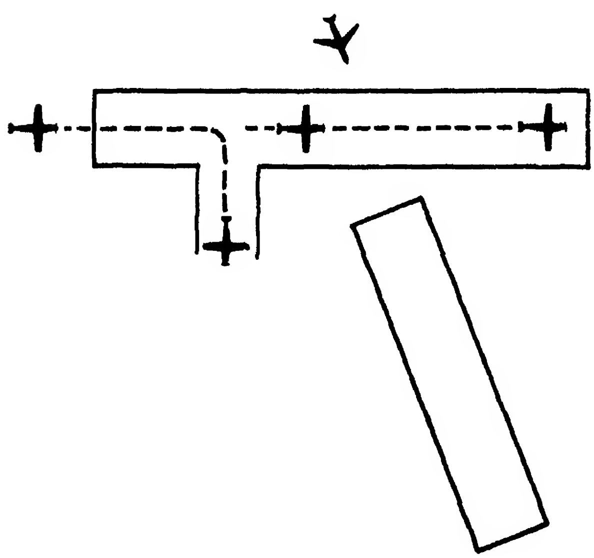


Figure 10-35.—Separation of arriving aircraft with intersecting flight paths.

EXERCISE

10-32. The *initial* approach segment is part of the ______ traffic pattern.

10-33. Final approach, base leg, and downwind leg are segments ______ traffic patterns.

10-34. List the item(s) of landing information which is/are always given to arriving VFR aircraft, regardless of other factors.

10-35. List the item of landing information which is issued to an aircraft which will fly an overhead pattern, that is required in all instances, but is not the same as the item(s) listed above.

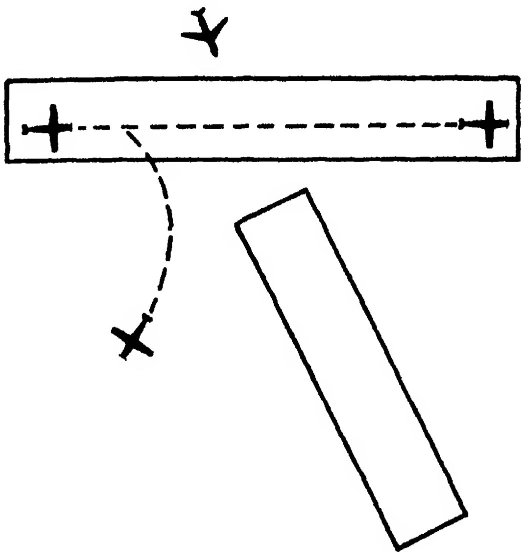


Figure 10-37.—Separation of a preceding departure and an arriving aircraft with intersecting flight paths.

10-36. When assigning a landing sequence to arriving aircraft, what items of information do you give in the advisory?

10-37. Give two examples of what you can say that will effect better spacing in the arriving traffic pattern.

10-38. A category III aircraft is arriving on a runway which has adequate distance reference points during the period from sunrise to sunset, and a succeeding category II aircraft is preparing to land on the same runway. What is the minimum acceptable runway separation?

10-39. A category II aircraft is departing on a runway that intersects a runway on which a category II aircraft is preparing to land. The time is between sunrise and sunset, and adequate distance reference points are available. What is the minimum acceptable runway separation?

10-40. A preceding category III aircraft is departing between sunrise and sunset on a runway having adequate distance reference points. Another category III aircraft is arriving on the same runway. What minimum separation is required in this instance if no other factors are involved?

10-41. A preceding category II aircraft has been cleared for touch-and-go. A succeeding category I aircraft will make a full stop landing on the same runway. There are adequate distance reference points and it is between sunset and sunrise. What is the minimum acceptable runway separation?

DEPARTURE, HELICOPTER, AND SPECIAL OPERATIONS PROCEDURES

Learning Objective: **State those procedures that pertain to fixed wing departure, helicopter, and special operations.**

DEPARTURE PROCEDURES

Aircraft are required to contact ground control, prior to taxiing, for the purpose of receiving appropriate taxi instructions. When issuing taxi instructions, direct the aircraft to the active runway by way of the shortest authorized route possible. If taxi routes are established by base authorities, then your instructions must be in accordance with them. Also, unless directed otherwise by a local base policy, you should give taxi precedence to turbojet aircraft (when requested by the pilot) over conventional-type aircraft when possible. The reason for this precedence is the high rate of fuel consumption of jet aircraft operating on the ground. Procedures for issuing taxi and takeoff information are similar to those used for issuing landing information.

Taxi and Departure Information

The ground controller provides departure information as appropriate to a departing aircraft. You may omit information currently contained in the ATIS broadcast if the pilot states the appropriate ATIS code. You may also omit the runway in use, wind, and altimeter setting if the pilot states "have numbers" or something similar. Otherwise, issue departure information by including the following:

1. Runway in use.
2. Surface wind.
3. Altimeter setting. This item need not be issued to local aircraft operators that have requested in writing its omission or to scheduled air carriers.
4. Time. When requested.
5. The official ceiling and visibility to VFR aircraft when the weather is below VFR conditions, and to IFR aircraft when the weather is below the highest takeoff minimums for the airport. If no takeoff minimums are published, issue ceiling and visibility when conditions are below VFR.
6. Taxi route information. Issue specific directions if the pilot requests it or you feel it necessary.

When taxi information is required, issue the following, as appropriate, in concise and easy-to-understand terms.

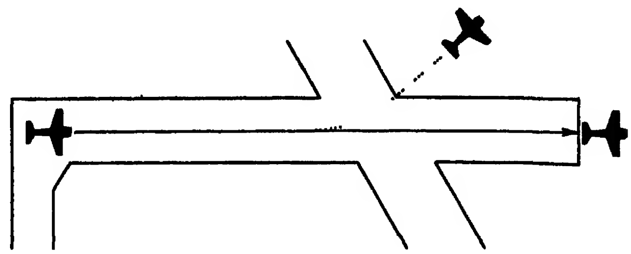
1. Route for the aircraft to follow.

NOTE: If an aircraft's position is in doubt, determine its exact position before issuing any taxi information.

2. Instructions for the aircraft to hold short of runways, taxiways, and traffic information, as necessary.

For example, you might say, "TAXI TO RUNWAY (NUMBER), VIA (ROUTE), TAXI ACROSS RUNWAY (NUMBER), THEN HOLD SHORT OF THE NEXT INTERSECTION, F-14 TAXIING NORTH."

Also, hold any taxiing aircraft a sufficient distance short of a runway so that an arriving or



201.144
Figure 10-38.—Separation of departing aircraft.

departing aircraft will not pass over or near it. This does not include aircraft making a restricted low approach.

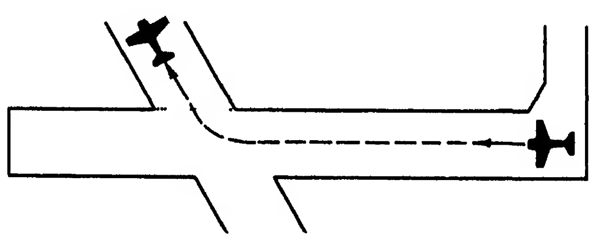
Departing IFR flights receive their ATC clearance on ground control frequency or a designated clearance delivery frequency. Navy pilots are required to "read back" ATC clearances that differ from the filed flight plan.

IFR flights should be informed of the appropriate departure control frequency before takeoff. This information should be issued on the clearance delivery or ground control frequency.

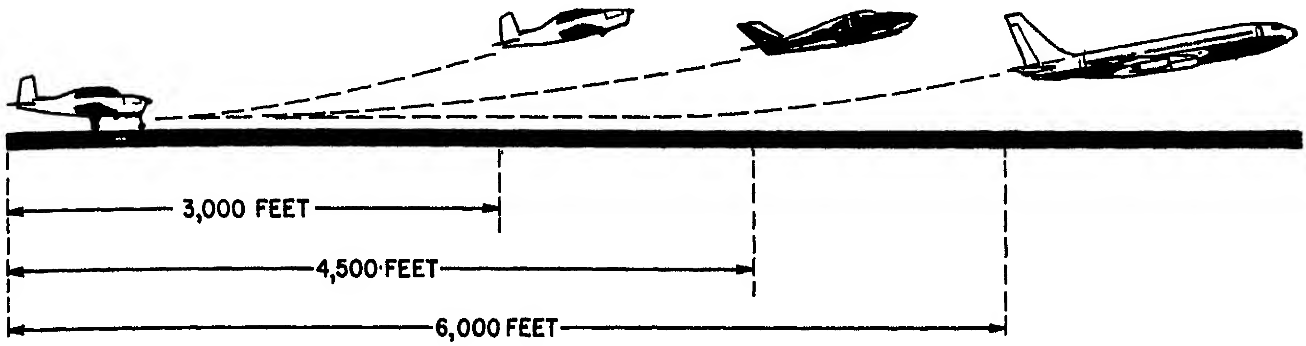
Departing aircraft will hold well clear of the duty runway until cleared for takeoff by the control tower.

Basic Departure Separation

For this part of our discussion, we will assume that you are once again working the local control position. Our departing aircraft has completed necessary preflight checks and is ready for takeoff. When adequate separation, in your



201.146
Figure 10-39.—Separation between departing and a preceding arriving aircraft.



201.145

Figure 10-40.—Separation of different category departing aircraft.

judgment, exists between the aircraft and all other known traffic, clear the aircraft for takeoff. Of course, situations arise whereby you cannot clear the aircraft for takeoff the instant the pilot advises he is ready for departure. This may be due to congested traffic or other conditions.

The basic VFR separation standards you must apply to departing aircraft are:

1. Separate two departing aircraft by ensuring that the succeeding aircraft does not begin takeoff roll until the preceding departure has crossed the runway end or has turned to avert any conflict. (See figure 10-38.)

2. Separate a departing aircraft from a preceding arriving aircraft by ensuring that the departure does not begin takeoff roll until the arrival has taxied off the runway. (See figure 10-39.)

Special Minimums

If you can determine distances by suitable landmarks, we can once again use the special aircraft category separation minimums discussed during arrival procedures. In this instance, unlike arrivals, the special minimums can be applied anytime of the day as long as distances can be determined. Based on the category of aircraft, you may apply the special minima as shown in figure 10-40, between successive departures. The first aircraft need only be airborne if the following minimum distance exists between aircraft:

1. When only category I aircraft are involved—3,000 feet.
2. When category I aircraft is preceded by a category II aircraft—3,000 feet.
3. When either the succeeding or both aircraft are category II—4,500 feet.
4. When either aircraft is a category III—6,000 feet.

Intersecting Runways

Separate a departing aircraft from another aircraft using an intersecting runway or nonintersecting runway when the flight paths intersect, by ensuring that it does not begin takeoff roll until one of the following conditions exist:

1. The preceding aircraft has departed and passed the intersection, has crossed the departure runway, or is airborne and turning to avert any conflict. (See figures 10-41 and 10-42.)

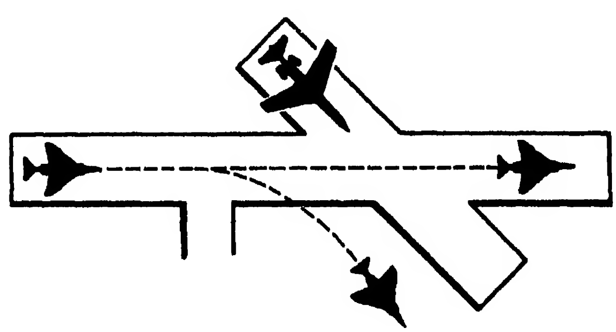


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Figure 10-41.—Separation between departing aircraft using intersecting runways.

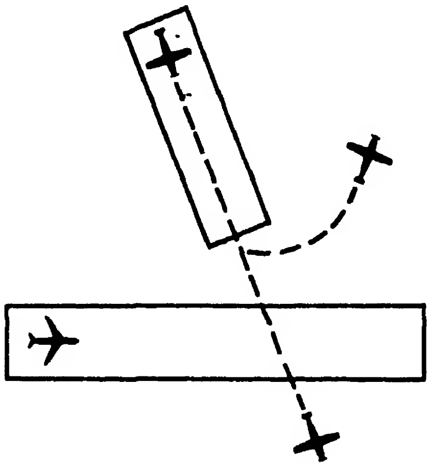

Figure 10-42.—Separation of departing aircraft with intersecting flight paths.

2. A preceding arriving aircraft has taxied off the landing runway, completed the landing roll, and will hold short of the intersection, passed the intersection, or has crossed over the departure runway. (See figures 10-43 and 10-44.)

Takeoff clearance need not be withheld until prescribed separation exists if there is a reasonable assurance it will exist when the aircraft starts takeoff roll.

Intersection Takeoff Separation

Since some aircraft do not require the entire runway length for takeoff, pilots often request to depart from some intermediate point along the runway. Controllers also may initiate intersection takeoffs to enhance airport capacities, reduce taxiing distances, minimize departure delays, and provide for more efficient movement of air traffic. Because of the effects of wake turbulence, you must pay particular attention to the separation standards and intersection takeoff procedures established in FAA Handbook 7110.65. For example, at one point the handbook states: "Separate a category I or II aircraft taking off from an intersection on the same runway (same or opposite direction takeoff) behind a preceding departing non-heavy category III aircraft by ensuring that it does not start takeoff roll until at least three minutes after the category III aircraft has taken off, unless a pilot has initiated a request to deviate from the 3-minute interval." A pilot's request for takeoff clearance does not initiate a waiver request; the request for takeoff must be accompanied by a request to deviate from the 3-minute rule. If a pilot does initiate a waiver request, you must issue a wake turbulence advisory before clearing the aircraft for takeoff.

The handbook also states, "Inform an aircraft when it is necessary to hold in order to provide the required 3-minute interval." You would do

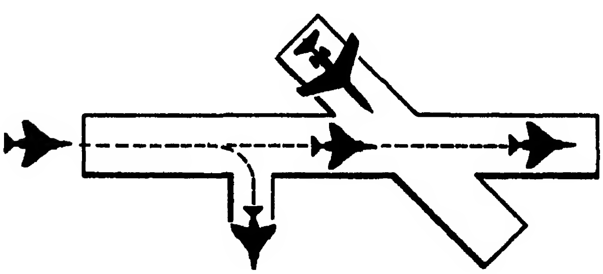

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Figure 10-43.—Separation between departing and arriving aircraft using intersecting runways.

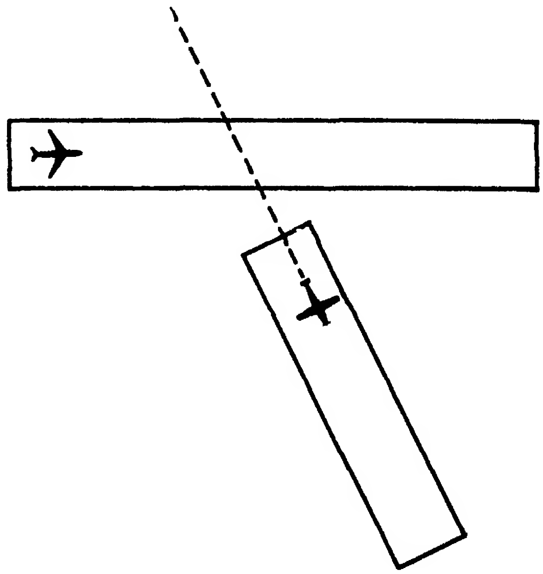


Figure 10-44.—Separation of a preceding arrival and a departure with intersecting flight paths.

this by instructing the aircraft to HOLD FOR WAKE TURBULENCE.

Helicopter Separation Standards

Normally, helicopters execute a rolling-type takeoff or landing into the wind, just as any other aircraft, although they do not require as much distance. Since helicopters do not necessarily require a runway, a separate area is usually specified on the airport for them to conduct their operations. This area is referred to as a helipad.

When providing separation between a helicopter and other aircraft operating in the airport area, you usually must rely upon the helicopter pilot for assurance that he is complying with your control instructions. This is because a loss of perspective occurs as the helicopter rises to a level above the ground, making it difficult to determine its exact position in relation to the surface. This situation occurs when the helicopter is moving or hovering and can cause you some moments of anxiety, especially when the operation is near the active runway. Helicopters performing air taxiing operations (normally not above 10 feet) within the boundary of the airport are considered to be taxiing aircraft and must be separated from other traffic accordingly. VFR helicopter separation standards are discussed in the following paragraphs.

Departing Helicopters

Separate a departing helicopter from other helicopters by ensuring that it does not take off until one of the following conditions exists:

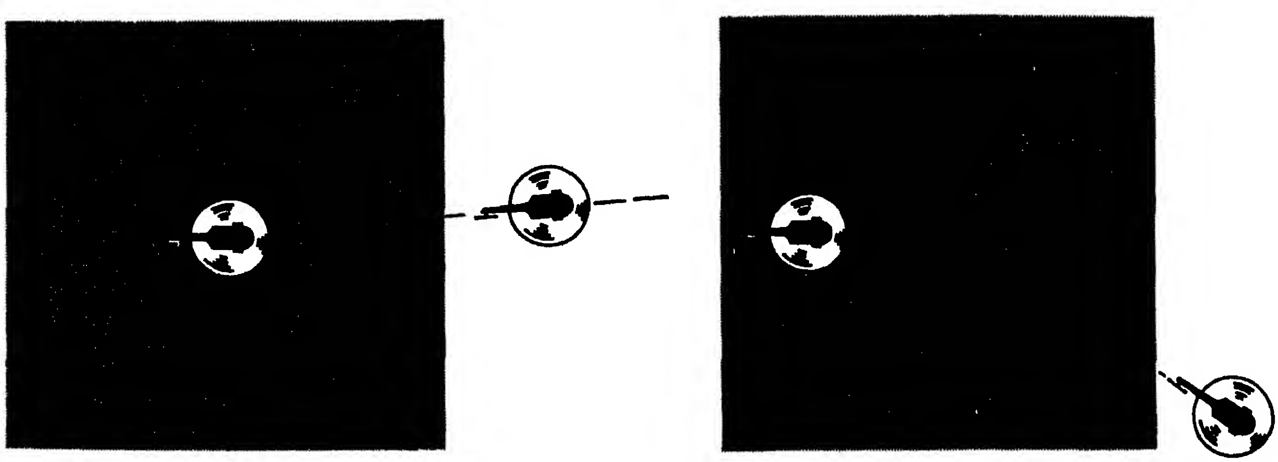
1. Succeeding Departures—The preceding departure is clear of the helipad, as shown in figure 10-45(A).

2. Departures and Arrivals—The departure must be held until the arrival has taxied off the helipad, as shown in figure 10-45(B).

Arriving Helicopters

Separate an arriving helicopter from other helicopters by ensuring that it does not land until one of the following conditions exists:

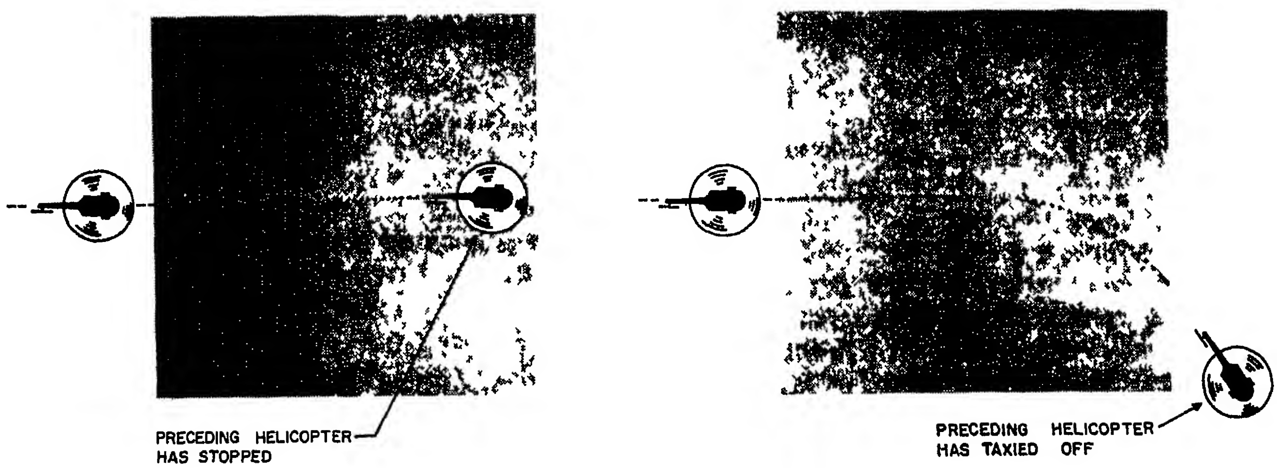
1. Succeeding Arrivals—The preceding arrival has either come to a stop or has



(A) (B)

201.155

Figure 10-45.—Separation of a departing helicopter. (A) From a preceding departure; (B) from a preceding arrival.



201.156

Figure 10-46.—Separation of an arriving helicopter from a preceding arrival.

taxied off the helipad, as shown in figure 10-46.

2. Arrivals and Departures—The preceding departure is clear of the helipad, as shown in figure 10-47.

Simultaneous Operations

Simultaneous helicopter landings or takeoffs may be authorized provided the distance between the landing/takeoff points is at least 200 feet and the courses to be flown do not conflict with each other. In cases where surface markers are not visible for you to determine the 200-foot minimum, instruct the pilot to remain at least 200 feet from all other helicopter operations. Figure 10-48 shows this separation being used for simultaneous operations.

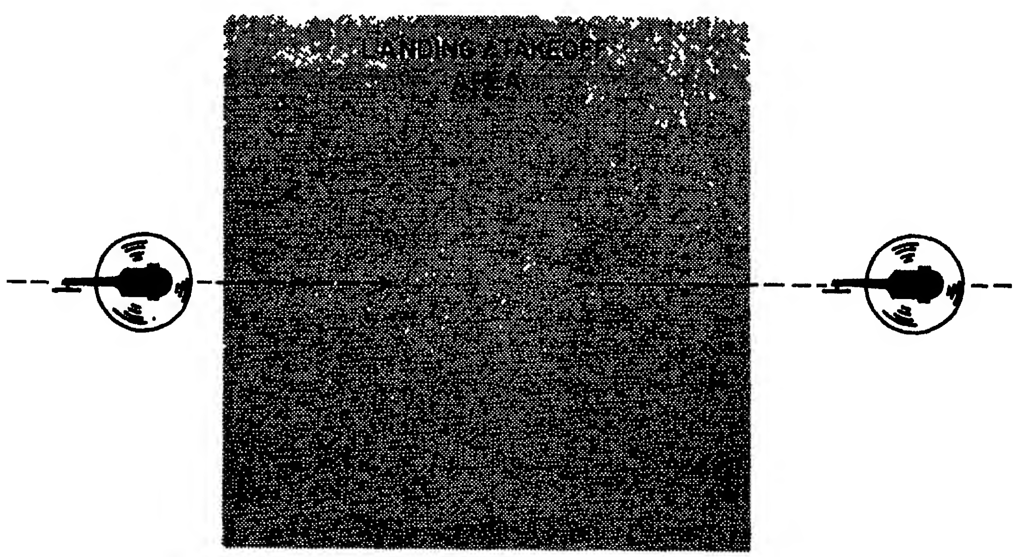


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Figure 10-47.—Separation of an arriving helicopter from a preceding departure.

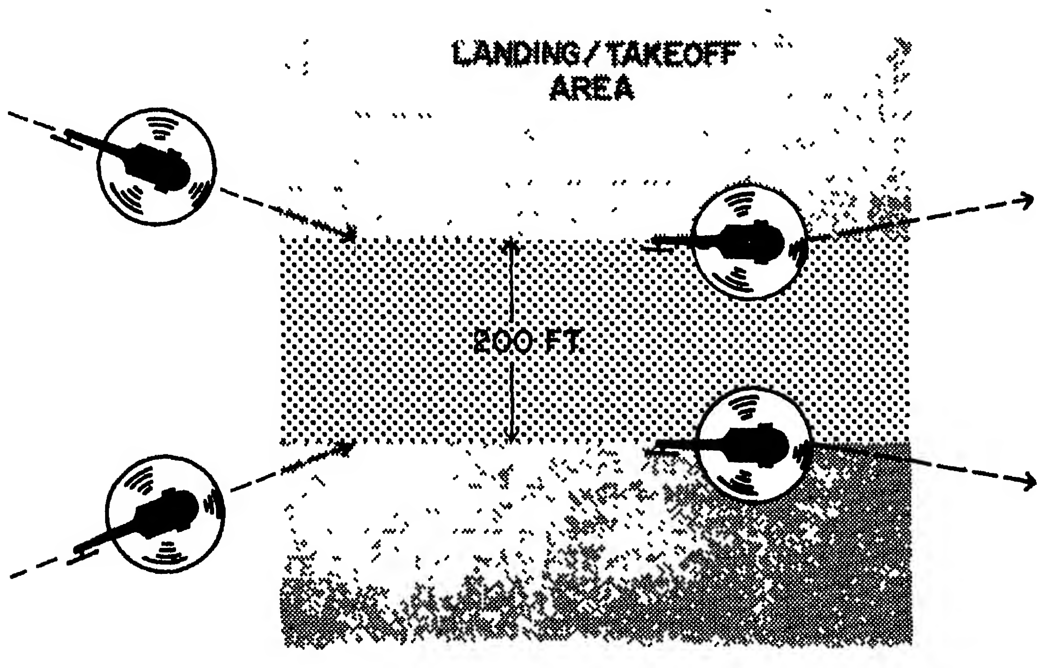

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Figure 10-48.—Separation of simultaneous helicopter operations.

General VFR Helicopter Operations

Where helicopter and fixed-wing aircraft use the same facility, a controller must consider the maneuverability and operational characteristics of helicopters when issuing instructions and information to establish a smooth flow of traffic. Helicopters do not necessarily conform to a standard traffic pattern as do fixed wing aircraft. Local procedures may be established to ensure uniformity of helicopter operations. Local pilots would probably be familiar with such local procedures, but transient pilots would depend upon the controller to issue appropriate instructions. Conflicting flight paths and movements between helicopters and fixed wing aircraft must be prevented.

Pilots and helicopters should request permission from the control tower to cross a duty runway, or runway in use. The controller should then issue appropriate instructions based upon an assessment of the current traffic situation.

Navy helicopter flights within a control zone should not exceed an altitude of 500 feet unless authorized to do so by the control tower or other appropriate agency.

Helicopter training flights should stay well clear of other traffic. When they are within the boundaries of the airfield, the pilot should guard the tower frequency so a controller can keep the pilot informed of current traffic information.

Practice autorotations may be conducted within the limits of the field boundaries over a surface where a full autorotation might be safely completed, and which is readily accessible to crash and firefighting equipment. Practice autorotations require the approval of the control tower.

SIMULTANEOUS OPERATIONS ON PARALLEL RUNWAYS

From our previous discussion of arrival and departure separation standards, you might think parallel runways would add to the complexity of air traffic control. This may be true; however, when certain conditions are met, simultaneous operations are authorized on parallel runways, parallel landing strips, or on a runway and a parallel landing strip. This will increase the

volume of traffic that can be handled in a given period, but should reduce the complexity of control.

Simultaneous Same Direction Operations

When authorizing simultaneous, same direction operations on parallel runways, parallel landing strips, or on a runway and a parallel landing strip, operations must be conducted in VFR conditions unless visual separation is applied. In addition, two-way radio communication must be maintained with the aircraft involved, pertinent traffic information issued, and the distance between the runways or landing strips must be in accordance with the minima in table 10-2. Where different categories of aircraft are involved, use the greater minimum distance shown in the table. Consider runways less than the required distance apart as a single or the same runway. When heavy jet aircraft are involved, the required distance between parallel runways is 2500 feet because of the possible effects of wake turbulence. As we said earlier in this chapter, the special wake turbulence separation minima that you should become familiar with are contained in FAA Handbook 7110.65.

Table 10-2.—Criteria for simultaneous, same direction operations on parallel runways

Aircraft type	Minimum distance in feet between............	
	Runway centerlines	Adjacent edges of runway and landing strips
Light-weight, single-engine, propeller-driven	300	200
Twin-engine, propeller-driven	500	400
All others	700	600

Simultaneous Opposite Direction Operations

Simultaneous opposite direction operations on parallel runways, on parallel landing strips, or on a runway and a parallel landing strip must be conducted in VFR conditions. This type operation is NOT authorized between sunset and sunrise on adjacent parallel landing strips or a runway and an adjacent parallel landing strip but is authorized on parallel runways. Two-way radio communication must be maintained between the aircraft involved and pertinent traffic information issued. The required distances between runways or landing strips are shown in table 10-3 according to the time of the operation.

AERIAL TOW TARGET OPERATIONS

Aerial tow targets and related equipment are used in gunnery practice by ships and shore installations and in air-to-air firing exercises. Towing operations enable gunners to fire at targets that simulate moving aircraft in speed, shape, and maneuvers.

Most aerial tow targets presently employed are of the type that can be released, or trailed, behind the aircraft in flight and retracted when the mission is completed. These targets normally do not require any special consideration concerning

Table 10-3.—Criteria for simultaneous, opposite direction operations on parallel runways

Time of operation	Minimum distance in feet between............	
	Runway centerlines	Adjacent edges of runway and landing strips
Between sunrise and sunset	1400	1400
Between sunset and sunrise	2800	Not authorized

ɪrport traffic control. However, the possibility f a mechanical malfunction exists, and a pilot ɪay not be able to retract the target. In such cases ɪe pilot may desire to make a low approach over ɪe airport and drop the target in an area from hich it could be retrieved. The local Air Opera- ons Manual designates specific procedures and ·eas for dropping towed targets.

It should be kept in mind that an aircraft with tow target in the traffic pattern is a definite azard and you have the responsibility of con- ·olling traffic accordingly. This may require ddditional spacing of traffic or having other ·affic vacate the traffic pattern until the tow drop complete.

IELD CARRIER ANDING PRACTICE

Involvement of the Air Traffic Controller in ɪe procedures of field carrier landing practice ᶠCLP) stems from the AC's position of control f aircraft at and around the airport. The extent) which the AC is called upon to exercise con- ·ol and handle other aspects connected with CLP is discussed in the following sections.

The landing signal officer (LSO) is an ĸperienced carrier pilot, designated and trained y the Navy to assist and instruct pilots in ɪrrier and field carrier landing techniques. The SO has direct responsibility for the aircraft in ɪe FCLP pattern. The tower retains overall con- ·ol of the traffic, which means the control tower ·ill issue instructions whenever there is danger resent to the aircraft in the pattern. To effec- vely accomplish this, there must be close coor- ination between the tower and the LSO ɜgarding any emergency action that may be ecessary. In addition, tower operators can relay ny information to the LSO pertaining to the air- raft in the pattern if it will result in safer opera- ons. The only instructions, other than those ;sued by the control tower during FCLP when hazardous condition exists, are initial takeoff learance and taxi instructions. All other instruc- ons given to the pilots of aircraft conducting 'CLP are given by the LSO.

FCLP is the most hazardous routine opera- ɪon conducted on the field. The tower operator ɪust be constantly alert for any emergency /hile these operations are in progress. These emergencies may result from spins, stalls, and ground loops, due to the slow speed and low altitude of the aircraft in the pattern. While conducting FCLP, more than the normal amount of crash equipment is required to be available on the field because of the greater risks or hazards involved. Station instructions designate the positioning of this equipment and the amount required.

Pilots receive an extensive training program at shore installations, preparing them for actual carrier landings prior to going aboard an aircraft carrier. Therefore, to approximate shipboard landing conditions, a runway is marked off in size and shape similar to the flight deck of an aircraft carrier. Landing area markings, discussed in an earlier chapter, sometimes serve as a simulated flight deck for FCLP. However, when it is impractical to conduct FCLP operations on the landing area marking, additional simulated flight deck markings are painted at appropriate locations on the runway. Lights are used to outline the runway for nighttime use. These may be either portable lights or smudge pots.

The FCLP pattern is usually a touch-and-go pattern. This means that the aircraft is able to stay in the pattern and complete more approaches. When the aircraft takes off, the pilot will usually turn slightly to the right so as to leave the runway clear of turbulence. An aircraft entering turbulence from an aircraft ahead may have trouble recovering because of the low altitude, and a crash may result. The airspeeds used vary with the type of aircraft; however, they are normally not much above stalling speeds. In their final approach, aircraft are controlled by the LSO. The LSO may, at his discretion, wave off an aircraft at any point in the landing approach. The pilot will land after completion of the required number of approaches, or when low on fuel. The tower controller will then issue instructions to the pilot for taxiing back to the parking area.

EXERCISE

10-42. If you can determine distances by reference to suitable landmarks, what minimum runway separation must exist between a departing category I aircraft

followed by a departing category II aircraft?

10-43. What is the required separation between a preceding departing category III aircraft and a category II aircraft taking off from an intersection on the same runway?

10-44. A category II aircraft has been cleared for low approach and another category II aircraft is awaiting takeoff clearance. It is between sunset and sunrise and adequate distance reference marks are available. When can the succeeding aircraft be cleared for takeoff?

10-45. Two helicopters are arriving at the same helipad. Before the second helicopter lands, what action(s) must be completed by the first helicopter?

10-46. When conducting simultaneous same direction operations on parallel runways with category I aircraft, what is the required minimum distance between runway centerlines?

10-47. In the following situation, what runway separation, if any, would you apply? Explain.

Situation:

A category III aircraft has been cleared to depart runway 9L and a category I aircraft will land on runway 9R. The distance between runway centerlines is 600 feet. The time is between sunset and sunrise and suitable distance reference marks are available.

10-48. When FCLPs are being conducted, what information does the tower issue to the aircraft involved?

CHAPTER 11

IFR/SVFR CONTROL PROCEDURES

Controlling air traffic under IFR conditions is a demanding task. Controllers must be precise in their actions, considering the increased responsibilities as compared to VFR air traffic control. In the case of the latter, clearances and instructions were issued to assist the pilot in avoiding collision and to enhance the flow of air traffic. In comparison, clearances and instructions are issued to IFR traffic for the purpose of keeping all such traffic appropriately separated and at a safe altitude above terrain.

As an AC in the Navy, you will most likely be involved with the control of IFR traffic at a terminal facility. The control of en route IFR traffic is primarily the responsibility of the Air Route Traffic Control Center (ARTCC) in which the flight is operating. The ARTCC is responsible for the control of aircraft operating IFR within controlled areas en route from one terminal area to another and for providing approach control service where approach control facilities are not established. In your duty assignments, you may or may not be responsible for the control of instrument traffic as a center controller. In the United States, all ARTCCs are FAA operated. In a few overseas areas, you may work in military-operated ARTCCs. However, most overseas en route control facilities, such as Oceanic Area Control Centers (OACCs) are under the jurisdiction of International Civil Aviation Organization (ICAO) agencies. Even though you may not perform the duties of an en route air traffic controller at this time, it is important that you know the separation standards established by the FAA Air Traffic Control Handbook 7110.65. The standards and procedures used to control en route air traffic overlap into other areas of control.

As with any difficult procedure, the logical start is with basic details. The intent of this chapter is to discuss IFR/SVFR (Special VFR) air traffic control procedures and minima so you can describe them, and with the necessary supervised experience, apply them to the actual control of IFR air traffic.

Learning Objective: **Recognize control procedures specified for IFR traffic control.**

NATIONAL AIRSPACE SYSTEM

The national airspace system as it exists today began to develop in 1918 with the U.S. Post Office airmail service. Radio equipment was installed near telephones, providing a link of air and ground communications for keeping track of air traffic.

Lighted airways were set up using rotating light beacons, spaced at specific intervals, by which pilots could navigate. Coded lights were later added to the rotating beacons so that pilots with knowledge of the code could determine their distance from a certain reference point. Low-frequency radio range stations were established and became a government-operated system for aircraft navigation when landmarks and lighted airways were obscured by clouds, etc. In striving for increased reliability and to meet increasing air traffic needs, several types of air navigation aids were developed and put into general use. Military technology added impetus to the drive to provide the best possible navigation aids for use within national airspace with contributions such as radar, Identification Friend or Foe (IFF), and tactical air navigation (TACAN).

The Federal Aviation Act of 1958 established the Federal Aviation Administration (FAA) which is charged by Congress with the safe and efficient use of airspace of the U.S. This includes military aircraft operations within the U.S. airspace, hence the required compliance of Navy ACs with air traffic rules and regulations of the FAA.

As you learned in chapter 2, two route systems have been established for air navigational purposes within the contiguous U.S.—the Federal airway system and the jet route system. The Federal airway system consists of airways designated from not less than 1,200 feet above the surface, up to but not including 18,000 feet MSL, and is designated to serve aircraft which operate at these altitudes. They are predicated solely on VOR/VORTAC NAVAIDS. They are designated on aeronautical charts by a V and referred to orally as Victor airways. The jet route system consists of jet routes established from 18,000 feet MSL to FL 450 inclusive, and are designed to serve aircraft which operate at these altitudes. They are identified by a J on aeronautical charts.

The airspace structure above FL 450 is designed to permit free selection of routes. Navigation is conducted by NAVAIDS serving the jet route system provided the aids are not more than 200 miles apart. Flight above FL 600 must contain at least one fix within each Air Route Traffic Control Center's (ARTCC) area through which flight is planned without regard to distance between fixes.

IFR air traffic control service is provided within controlled airspace. This controlled airspace includes Federal airways, jet routes, control areas, transition areas, control zones, and the continental control area. These areas are described in chapter 2 and appendix D of this training manual.

IFR CONTROL PROCEDURES

The procedures and minima which apply when providing IFR air traffic control service are those contained in the Air Traffic Control Handbook 7110.65. When other procedures are contained in a Letter of Agreement, or other appropriate FAA or military document, they may only supplement the ATC Handbook. Any minima they specify cannot be less than those in the ATC Handbook 7110.65 unless appropriate military authority has authorized application of reduced separation between military aircraft in special procedures. The ultimate authority for naval ATC procedures is CNO. Deviation is also permitted when necessary to conform with pertinent ICAO Documents, National Rules of the Air, or special agreements in airspace outside the U.S. and its possessions where the U.S. provides air traffic control service.

Military procedures in the form of additions, modifications, and exceptions to the basic FAA procedure are provided in the ATC Handbook 7110.65 when a common procedure has not been attained or to fulfill a specific requirement. These military procedures are applied by ATC facilities operated by the designated military service, by ATC facilities supporting a designated military service exclusively, or by other ATC facilities when specified in a Letter of Agreement.

IFR CONTROL RESPONSIBILITY

Air Route Traffic Control Centers (ARTCCs) provide air traffic control service to aircraft operating on an IFR flight plan within controlled airspace principally during the en route phase of flight.

Approach control service is normally provided by a terminal area traffic control facility for arriving and departing IFR aircraft and occasionally for VFR traffic.

Authority to establish an approach control facility at a naval airfield is delegated to the Commanding Officer by the FAA. When established, approach control authority may be exercised through a tower, or a mobile or fixed radar facility.

NOTE: These radar facilities and the specific duties of those personnel assigned to them are discussed in chapter 13 of this manual and OPNAVINST 3721.1.

Prior to the actual implementation of approach control procedures, coordination with local FAA officials must be undertaken and a tentative local Letter of Agreement drawn up.

This tentative Letter of Agreement contains all facets of agreed approach control functions and delineates the responsibilities of the FAA and the naval ATC facility.

A copy of this tentative Letter of Agreement together with a request to establish approach control facilities, is then forwarded to the Chief of Naval Operations (CNO) for approval. If additional personnel or electronic equipment are required in providing this service, this requirement should also be included.

Upon receipt of approval from CNO a formal Letter of Agreement is executed with the local FAA air traffic control authorities. A copy of this finalized version must be sent to CNO for record purposes.

Guidelines for the development and preparation of Letters of Agreement between the Navy and FAA are contained in OPNAVINST 3721.1.

Although you will normally not be directly concerned with the preparation or revision of a Letter of Agreement, you will, by necessity, be required to know and understand the contents of this important document.

It should be pointed out that a Letter of Agreement is required to be executed not only for the establishment of an approach control facility but also for a control tower, a ground controlled approach (GCA) unit, or whenever any new type of procedure is initiated; i.e., standard instrument departures (SIDs), single frequency approaches (SFAs), etc.

A copy of the formal Letter of Agreement for your ATC facility should be contained within the local procedures manual.

PRIORITY OF SERVICE

First priority is given to the separation of aircraft to comply with the procedure and minima prescribed for the control of IFR traffic. Any other service or information is provided to the extent possible.

Radar procedures should be used in preference to nonradar procedures to the extent practicable, consistent with workload, communications, and equipment capabilities. However, nonradar separation may be used in preference to radar separation when an operational advantage will be gained. One situation may be where vertical separation would preclude excessive vectoring.

Air traffic control service is provided on a "first come, first serve" basis as circumstances allow. For example, it is solely the pilot's prerogative to cancel his IFR flight plan, but a retention of an IFR flight plan does not afford priority over VFR aircraft. The pilot may be required to adjust his flight path to enter a traffic pattern in sequence with arriving VFR aircraft. Exceptions to the first come, first serve rule do exist for certain types of aircraft operations such as emergency, air evacuation (AIREVAC), Presidential, and Vice Presidential aircraft.

TRANSFER OF IFR CONTROL RESPONSIBILITY

Control responsibility must be transferred between facilities or between controllers within a facility, at a specified time, fix, or altitude. Additionally, any potential conflict with other aircraft under the jurisdiction of the transferring facility or controller must be eliminated prior to the transfer of control responsibility.

When you transfer control of an aircraft while it is within your area of jurisdiction, issue any instructions to the receiving controller that may be necessary to provide separation from other aircraft for which you have separation responsibility.

Assume control of an aircraft only after it is in your area of jurisdiction unless specifically coordinated or as specified by Letter of Agreement or Facility Directive.

If you need to change an aircraft's heading, route, speed, or altitude within another controller's area of jurisdiction, coordinate such changes with that controller and, as required, any intervening controller through whose area the aircraft will pass prior to making the change.

TRANSFER OF RADIO COMMUNICATIONS

Transfer communications before an aircraft enters the receiving controller's area unless previously coordinated. Normally, when you transfer communications specify the name of the facility or control position to be contacted, the frequency to be used, and the time, fix, altitude, or specifically when to contact the facility.

FORMATION FLIGHTS

Formation flights are treated as single aircraft unless the formation leader requests that ATC separate individual aircraft. When individual control is requested, issue advisory information to assist the pilots in attaining separation. Once pilot reports indicate that separation has been established, issue control instructions as required.

NOTE: Separation responsibility between aircraft within the formation during transition to individual control rests with the pilots concerned until standard separation has been attained.

IFR CLEARANCE DELIVERY AND RELAY

IFR clearances issued by a facility other than the originating facility must be relayed verbatim. A non-ATC facility would prefix the clearance with the prefatory phrase "ATC clears." Such facilities would handle a relay of advice or a request for information in the same manner; i.e., "ATC advises," or "ATC requests." When a clearance, information, or a request for information is issued to an ATC facility or to an aircraft by direct ATC communications, the "ATC" portion of the prefatory phrase is omitted.

To correctly apply this procedure, refer to the definition of an ATC facility and ATC service. These definitions are included in appendix B of this training manual.

When appropriate, specific delivery instructions may be issued with a clearance for relay, such as an "attempt delivery" time or a "cancellation" time which must be adhered to by the relaying facility. The ATC facility originating the clearance should be advised if the requirements of specific delivery instructions are not met.

IFR clearance items and the sequence in which they should be issued to IFR traffic are as follows:

1. Aircraft identification.
2. Clearance limit or approach procedure.
3. Departure procedure or Standard Instrument Departure (SID).
4. Route of flight.
5. Altitude data in the order flown.
6. Holding instructions if a delay is anticipated.
7. Special or supplementary instructions as required.
8. Frequency and beacon code information.

SIGNIFICANT WEATHER

Significant weather information includes pilot reports or observed indications on radar concerning areas of strong frontal activity, squall lines, heavy thunderstorms, widespread fog, moderate to heavy icing, turbulence including CAT (clear air turbulence) of moderate or greater intensity, or similar conditions pertinent to safety of flight.

Every assistance should be given pilots to enable them to avoid areas of significant weather. When a requested deviation to avoid such areas cannot be approved due to traffic conditions, the altitude or route of the conflicting traffic may be changed to permit approval if there is reasonable assurance that the action will not place the conflicting aircraft in hazardous weather conditions.

Pilot-reported information about significant weather conditions should be relayed to other aircraft concerned and the appropriate weather service.

ALTIMETER SETTING INFORMATION

Altimeter settings issued to IFR flights must be current settings obtained from direct-reading instruments or received directly from weather reporting stations. All Automated Radar Terminal System (ARTS) facilities shall keep the computer-entered altimeter setting current at all times.

When issuing an altimeter setting to an aircraft, you must identify the source of the setting for a location other than your facility. The time of the report must also be included if it is more than one hour old.

Aircraft operating below flight level 180 must be issued the associated altimeter setting of compulsory reporting points when reporting over such points. If in "radar contact," issue the altimeter setting when the aircraft is observed passing or adjacent to compulsory reporting points. (Pilots discontinue making position reports when informed of "radar contact.")

When you clear an aircraft to descend from a flight level to an altitude below the lowest usable flight level, issue the altimeter setting for the weather reporting station nearest the aircraft's position. (See FAR 91.81 in appendix D.)

ALTITUDE VERIFICATION

Request pilots to verify their altitude upon initial contact after you have received control jurisdiction from another facility or after communications are established with an aircraft departing from another airport under your facility's control jurisdiction unless verification is provided by either direct altitude readout or by the pilot at the time of initial contact.

NOTE: Altitude readout determining equipment will be discussed in the chapter 12.

EXAMPLE: VERIFY AT EIGHT THOUSAND.

You need not verify the aircraft's altitude when, on initial contact, you assign a new altitude to an aircraft that is climbing or descending.

If the altitude readout indicates a discrepancy of 300 feet or more from the assigned altitude and the aircraft is in level flight, request the pilot to verify altitude.

In instances where the pilot confirms a discrepancy of 300 feet or more between the actual altitude and the transponder altitude readout, instruct the pilot to secure the altitude reporting portion of this transponder and advise him of the reason.

In the event that you are unable to verify the altitude discrepancy, ensure that standard radar separation is applied between the affected aircraft and any other radar-identified IFR aircraft.

NONRECEIPT OF POSITION REPORTS

When a position report affecting separation is not received, take action to obtain the report not later than five minutes after the aircraft was estimated over the fix. Do not require an aircraft to make the same report to more than one facility.

RADIO COMMUNICATIONS FAILURE

When an IFR aircraft experiences two-way radio communications failure, air traffic control is based on anticipated pilot action. Pilot procedures are set forth in FAR 91.127 and listed in chapter 2 and appendix D of this Rate Training Manual. Take the following action, as appropriate, when two-way radio communications are lost with an IFR aircraft:

1. Broadcast clearances through any available means of communication, including the voice feature of NAVAIDS.
2. Attempt to reestablish communications by having the aircraft use its transponder or make turns, both of which might be considered an acknowledgment when observed on radar.
3. Broadcast a clearance for the aircraft to proceed to its filed alternate airport at the minimum en route altitude (MEA) if the aircraft operator concurs.

Unless radar separation is applied, when an IFR aircraft is unreported, the facility responsible must restrict or suspend other IFR traffic for 30 minutes after whichever of the following is applicable:

1. The time at which approach clearance was delivered to the pilot.
2. The expected further clearance (EFC) time delivered to the pilot.
3. The arrival time over the NAVAID serving the destination airport.
4. The current estimate, either the control facility's or the pilot's (whichever is later), at the NAVAID serving the destination airport.

After the 30-minute traffic suspension period has passed, normal air traffic control may be resumed if the operators or pilots of other aircraft concur.

APPROACH CONTROL INFORMATION

Unless specific items listed in the following approach information have been broadcast via Automatic Terminal Information Service (and

acknowledged by the pilot) you should provide them to aircraft at the time of first radio contact:

1. Approach clearance or type of approach to be expected if two or more approaches are published and the clearance limit does not indicate which will be used.

2. Runway in use.

3. Surface wind.

4. Ceiling and visibility if the ceiling at the airport is reported below 1000 feet or below the highest circling minimum, whichever is greater, or the visibility is less than three miles.

5. Altimeter setting.

Detailed procedures used in providing approach control service will not be discussed at this time; however, as you advance in the Air Traffic Controller rating you will have the opportunity to attend the Advanced Air Traffic Controller Course. This advanced schooling, coupled with your past experience, is designed to assist you in preparing to accept the challenge of controlling aircraft under actual instrument conditions.

EXERCISE

11-1. Congress has charged what organization with the responsibility for the safe and efficient use of the national airspace of the United States?

11-2. What altitudes are designated for use as victor airways?

11-3. In what airspace is IFR control service provided?

11-4. As an AC, you must give first priority to performing what service?

11-5. Air traffic control services are provided on what basis?

11-6. When should you assume control of an aircraft?

11-7. When transferring control responsibility of an aircraft, what action must the transferring controller take prior to the transfer of control?

11-8. When transferring control of an aircraft, unless previously coordinated, when should you transfer communication?

11-9. How should you prefix an IFR clearance which ARTCC requested you to relay to an aircraft?

11-10. At 1300, IFR flight Navy 123 reported over Olathe. The last altimeter setting Kansas City ARTCC had received from Olathe weather service was at 1155 and was issued to the pilot as follows:

NAVY ONE TWO THREE ALTIMETER TWO NINER NINER TWO

What, if anything, is wrong with this transmission?

For exercises 11-11 and 11-12, select from column B the rule for the issuance of altimeter settings

which applies to each IFR situation described in column A.

A. IFR Situations	B. Rules
11-11. An aircraft has been cleared to descend from a flight level to an altitude below the lowest usable flight level	(1) The controller must issue the setting for the reporting point
11-12 An aircraft under radar contact below FL 180 flies over or near a compulsory reporting point	(2) The controller must request the aircraft's altitude
	(3) The controller must issue the setting for the nearest weather reporting station

11-13. When should you take action to obtain a position report which affects the separation of aircraft?

11-14. For how long must other IFR traffic operations be suspended in a radar environment when an IFR aircraft is unreported?

NONRADAR IFR SEPARATION MINIMUMS AND METHODS

Pilots are required to file IFR flight plans and obtain an ATC clearance prior to conducting flight under instrument flight rules of FAR 91 within controlled airspace. Special VFR flights must obtain an ATC clearance prior to operations within control zones. By this procedure, ATC facilities know of all IFR and special VFR traffic operating within controlled airspace for which they are responsible. Thus, controllers are able to regulate traffic by issuance of clearances and instructions for the purpose of keeping such traffic separated.

There are three types of nonradar separation: vertical, longitudinal, and lateral. One of these must be in effect whenever separation is required. Exceptions to the above statement are instances when controllers or pilots are authorized to maintain visual separation between aircraft, or when pilots are authorized to operate IFR in accordance with a VFR restriction.

Each type of nonradar separation has established minimums to which controllers must adhere for safe operation. These minimums and the methods of establishing and maintaining them are discussed separately in this chapter.

Learning Objective: **Given selected problems involving IFR air traffic separation, determine the minimum applicable separation.**

SEPARATION MINIMUMS

The primary job in the control of instrument traffic is to provide separation between individual flights. You accomplish this by issuing clearances and instructions which have the effect of surrounding each aircraft with an area of airspace into which other known IFR traffic is not allowed to penetrate. As previously stated, there are three ways in which aircraft are separated—vertically, laterally, and longitudinally. Vertical separation is achieved by assigning different altitude levels to provide separation between aircraft. Longitudinal separation is accomplished by prescribing a minimum flying time or distance to be maintained between aircraft operating at the same altitude on the same, converging, or crossing courses. Lateral separation is accomplished by assigning different flight paths to aircraft that are operating at the same altitude level. Normally, only one of the three methods of separation is applied at a time. For control purposes, vertical separation is perhaps the easiest of the methods to apply.

Vertical Separation

Vertical separation occurs when traffic is staggered at different altitudes. For instance, if several aircraft are flying the same route of flight, on converging courses, or are operating on the same

airway, they can be assigned different altitude levels to effect vertical separation. Remember, the minimum vertical separation for flights operating up to and including FL 290 is 1000 feet. Above FL 290, the separation is increased to 2000 feet.

Normally, when an aircraft reports leaving an assigned altitude, the vacated altitude can be reassigned immediately to another aircraft. However, when severe turbulence is reported, the vacated altitude cannot be assigned to another aircraft until the aircraft previously at that altitude has reported at, or passed through, another altitude which is separated from the vacated altitude by at least 1000 feet or 2000 feet, whichever is appropriate. For example, assume that severe turbulence has been reported and an aircraft is descending from FL 300 to FL 260. Before FL 300 can be assigned to another aircraft, the aircraft originally at that altitude must report reaching FL 260 or passing through FL 280.

EXAMPLE OF PHRASEOLOGY: REPORT LEAVING/REACHING FLIGHT LEVEL TWO EIGHT ZERO: or, REPORT LEAVING ODD ALTITUDES; or SAY ALTITUDE.

When pilots of aircraft are in direct radio communication with each other during climb and descent, you can authorize them to maintain their own vertical separation. This relieves you from making numerous transmissions to both aircraft. When this procedure is used, you are relieved of the responsibility of providing separation between the aircraft until the climb or descent maneuvers are completed. Maintaining separation is the responsibility of the pilots concerned. The lower aircraft, if climbing, or the upper aircraft, if descending, is delegated the responsibility of maintaining the required vertical separation.

During specific circumstances, standard separation can be reduced for the control of instrument traffic. In the case of a special VFR flight and an IFR flight operating above it, the required separation standard can be reduced to 500 feet. This procedure and visual separation are normally used within terminal areas. Aircraft operating on VFR conditions on top clearances and those that have requested to maintain VFR conditions are exempt from the standard separation minimum used for the control of IFR traffic.

NOTE: Visual separation and SVFR fli
discussed later in this chapter.

Longitudinal Separation

Longitudinal separation is the spacing o
craft operating at the same altitude on the s
converging, or crossing courses by a mini
distance expressed in units of time, or a spe
distance determined through use of dist
measuring equipment (DME). DME separ
minimums can be applied only when direct
controller communications are maintained.
longitudinal separation is applied, the end
is that after one aircraft reports passing o
specified position, the succeeding aircraft
same altitude must not arrive over the same
tion with less than the minimum time or dis
separation required. The minimums use
dependent upon the speed of the aircraft inv
The different rules for minimum longitu
separation are as follows: (See figure 11-1

1. Three minutes, provided the lead ai
is maintaining a speed of at least 44 knots
than the following aircraft. If the aircraft inv
are using DME, 5-mile DME separation c
used to provide separation between the air
Either the 3-minute separation or the 5
separation rule can be used, provided one
following conditions exists:

- A departing aircraft follows a prec
aircraft which has taken off from the sa
adjacent airport.

- A departing aircraft follows a prec
en route aircraft which has reported over
serving the departure airport.

- An en route aircraft follows a prec
en route aircraft which has reported over the
fix.

2. Five minutes, provided the lead airc
maintaining a speed of at least 22 knots faste
the following aircraft. If the aircraft involv
using DME, 10-mile DME separation can b
to provide separation between the air
The 5-minute separation or the 10-mile sepa

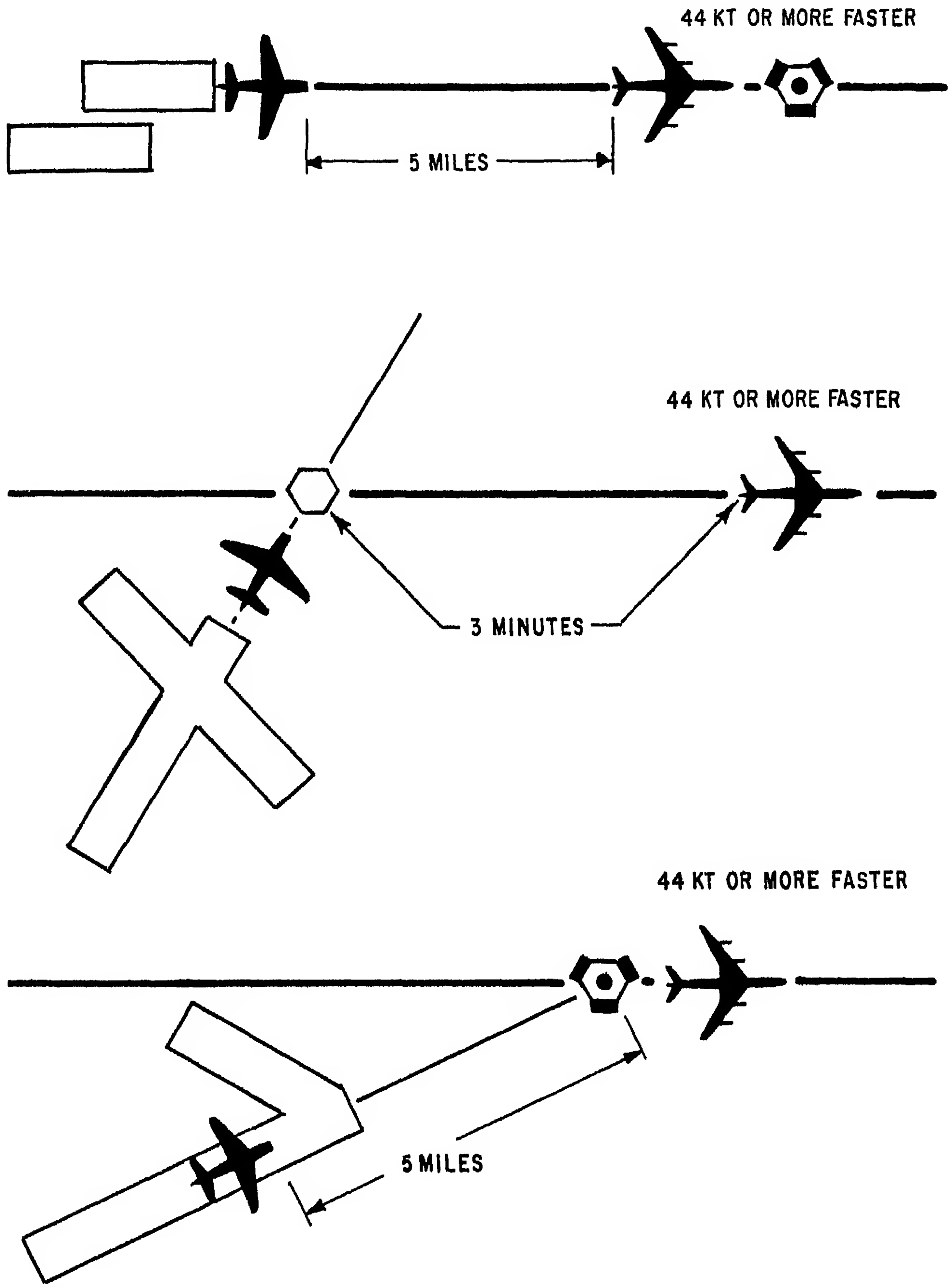

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Figure 11-1.—5-mile or 3-minute longitudinal separation.

can be used provided one of the following conditions exists (see figure 11-2):

- A departing aircraft follows a preceding aircraft which has taken off from the same or an adjacent airport.
- A departing aircraft follows a preceding en route aircraft which has reported over a fix serving the departure airport.
- An en route aircraft follows a preceding en route aircraft which has reported over the same fix.

3. When neither item 1 nor item 2 can be applied, then the separation standards are increased. The minimum longitudinal time separation is increased to 10 minutes. When DME is used, the minimum longitudinal separation is increased to 20 miles.

Longitudinal separation is established by any one of the following methods: (1) Require an aircraft to take off at a specified time; (2) require an en route aircraft to arrive over a fix at a specified time; or (3) require an en route aircraft to hold over a fix until a specified time. When pilots of aircraft on the same course in direct radio communication with each other concur, you can authorize the pilots to maintain their own separation by instructing the following aircraft to maintain the minimum longitudinal separation of 10 minutes, or, if DME is used, 20 miles.

The foregoing discussion relating to DME separations is applicable only when all aircraft

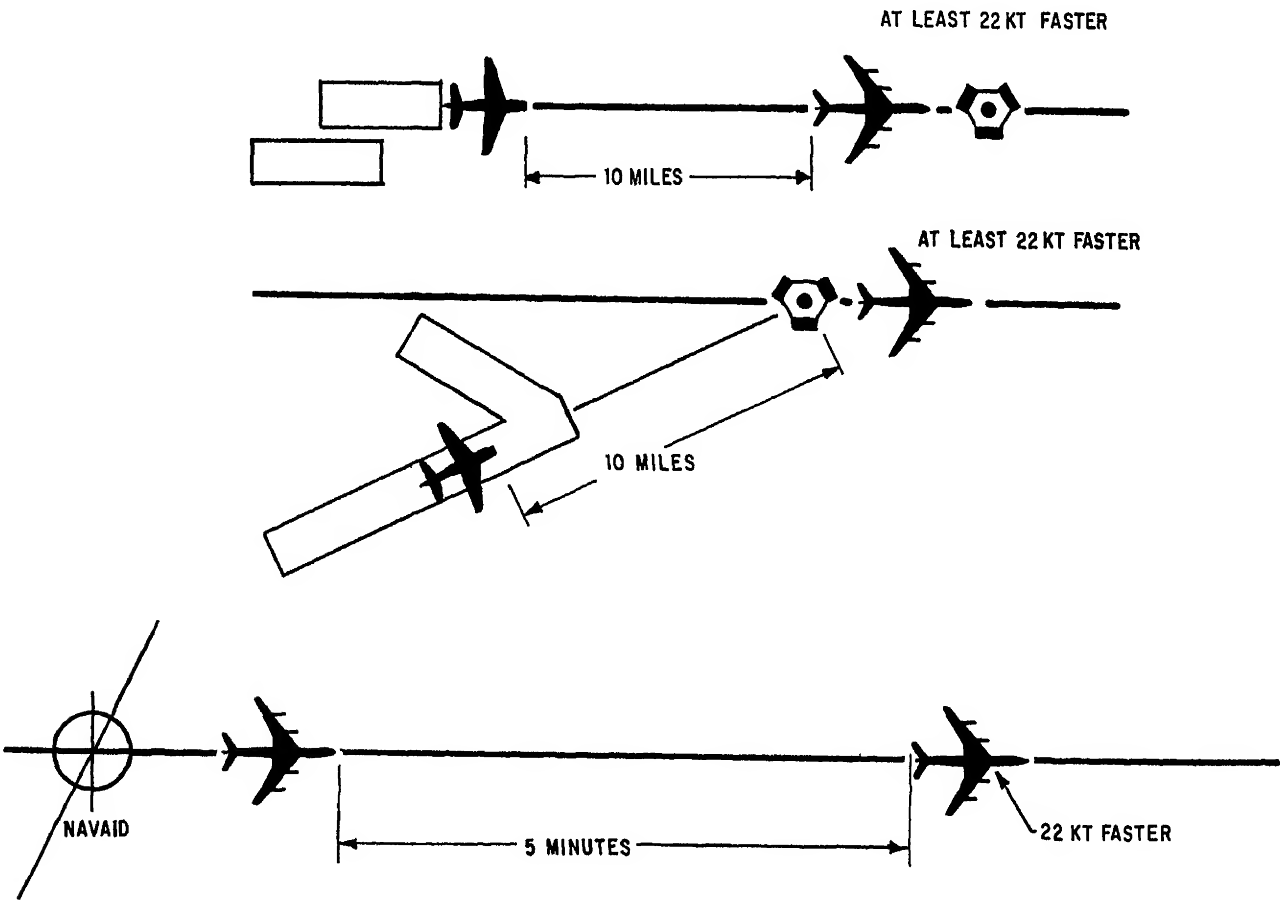

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Figure 11-2.—10-mile or 5-minute longitudinal separation.

involved are using DME. When one aircraft is using DME and the other is not, the aircraft that is using DME can be separated from the other aircraft by 30 miles. However, both of the following conditions must be met before this separation is authorized (see figure 11-3):

- The aircraft using DME derives distance information by reference to the same NAVAID over which the other aircraft has reported.

- The aircraft not using DME is within 15 minutes of the NAVAID.

Lateral Separation

Lateral separation is accomplished by assigning different flightpaths to aircraft that are operating at the same altitude level. As with longitudinal separation, lateral separation can be achieved by using different methods. Any one of the methods can be used, depending upon the current traffic situation.

To achieve lateral separation, aircraft are separated by one of the following methods: (1) Clear aircraft to fly on different routes, or airways, whose widths do not overlap; (2) clear aircraft below 18,000 feet to proceed to and report, or hold, over different geographical locations determined visually, or by reference to NAVAIDs; (3) clear aircraft to hold over different fixes provided the holding pattern airspace areas do not overlap each other or overlap other protected airspaces; or (4) clear departing aircraft to fly specified headings

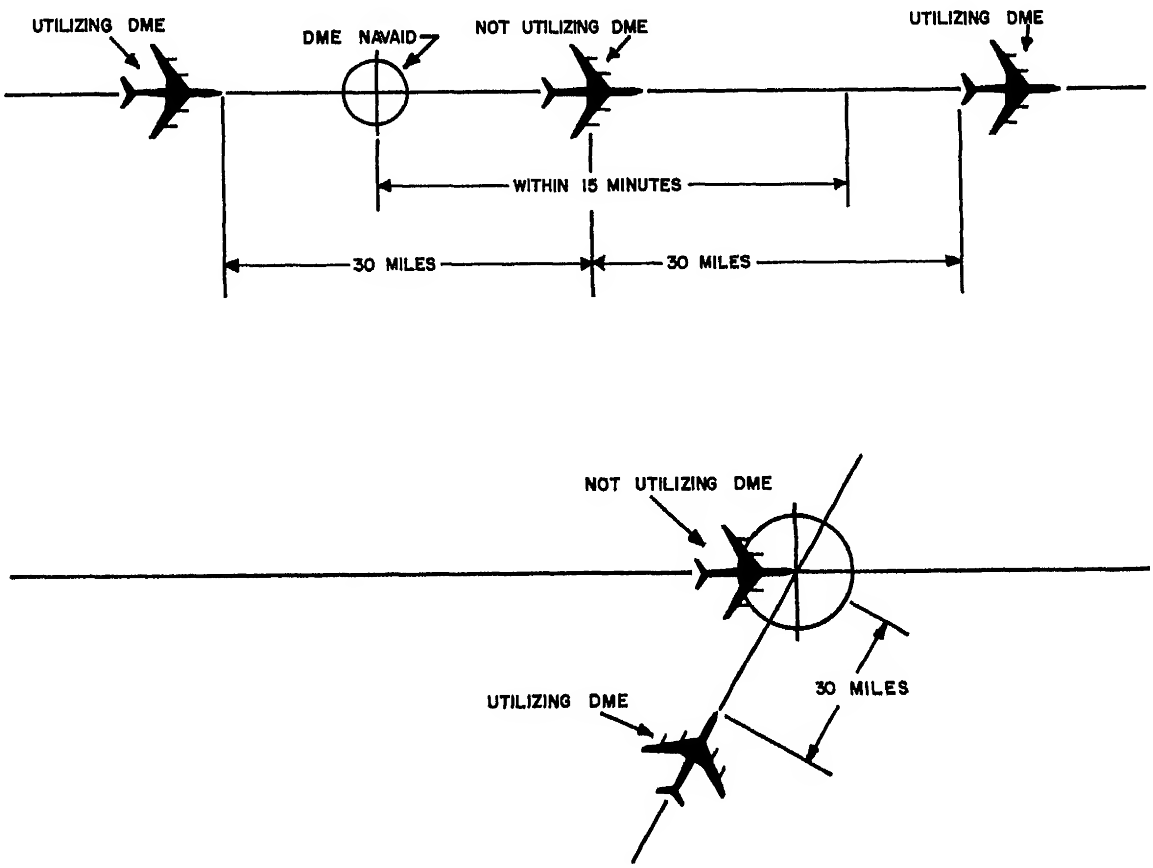

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Figure 11-3.—Separation of DME and non-DME equipped aircraft.

which diverge by at least 45°. (See figure 11-4.)

NOTE: Airspace protected for airways is based on the width described in FAR 71.5 and is normally four miles either side of centerline.

Lateral separation is considered to exist between aircraft established on radials of the same NAVAID that diverge by at least 15° when either aircraft is beyond the airspace to be protected for the other aircraft. (See figure 11-5.)

There is a table in ATC Handbook 7110.65 under the lateral separation section that shows appropriate distances necessary to clear the airspace to be protected for divergence angles from 15° to 90°. Since this type computation is one which should be predetermined and shown on charts located at or near operating positions rather than an on-the-spot-type separation, the table is not included here.

Lateral DME separation is applied by requiring aircraft using DME to fly an arc or arcs of a navigational aid.

Airspace to be protected along other than established airways or routes is as follows:

1. For direct courses and course changes of 15° or less at FL 600 and below, and any course change below FL 180, the width of the protected airspace is four miles on each side of the route to a point 51 miles from a NAVAID. Beyond the 51-mile point, the airspace increases in width, based on a 4.5° angle from the aid, to a width of ten miles on each side of the route at a distance of 130 miles. (See figure 11-6.)

2. For course changes of more than 15° through 90°, the airspace to be protected on the overflown side, beginning at a point where the course change begins, is as follows:

a. Below FL 180—same as paragraph 1.

b. FL 180 to FL 230 inclusive—14 miles.

c. Above FL 230 to FL 600 inclusive—17 miles.

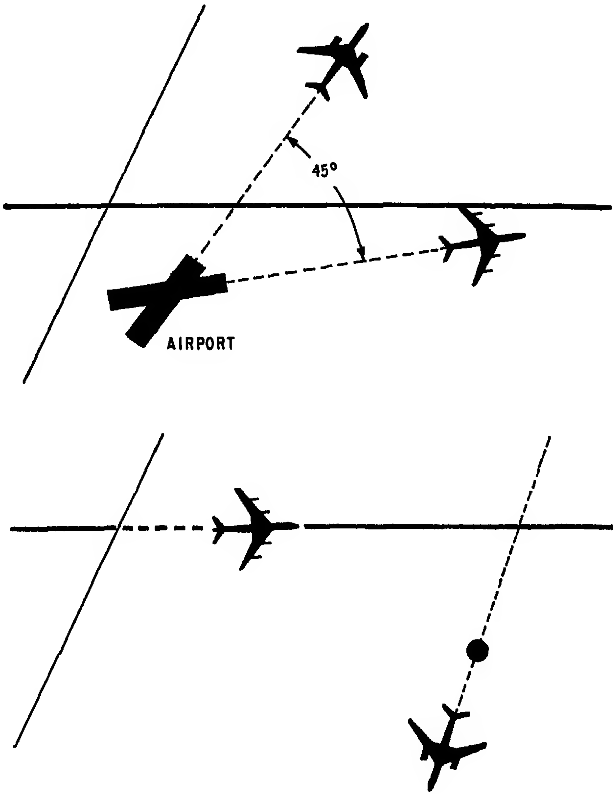

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Figure 11-4.—Two illustrations of lateral separation.

3. For course changes of more than 90° through 180°, the airspace to be protected on the overflown side, beginning at a point where the course change begins, is as follows:

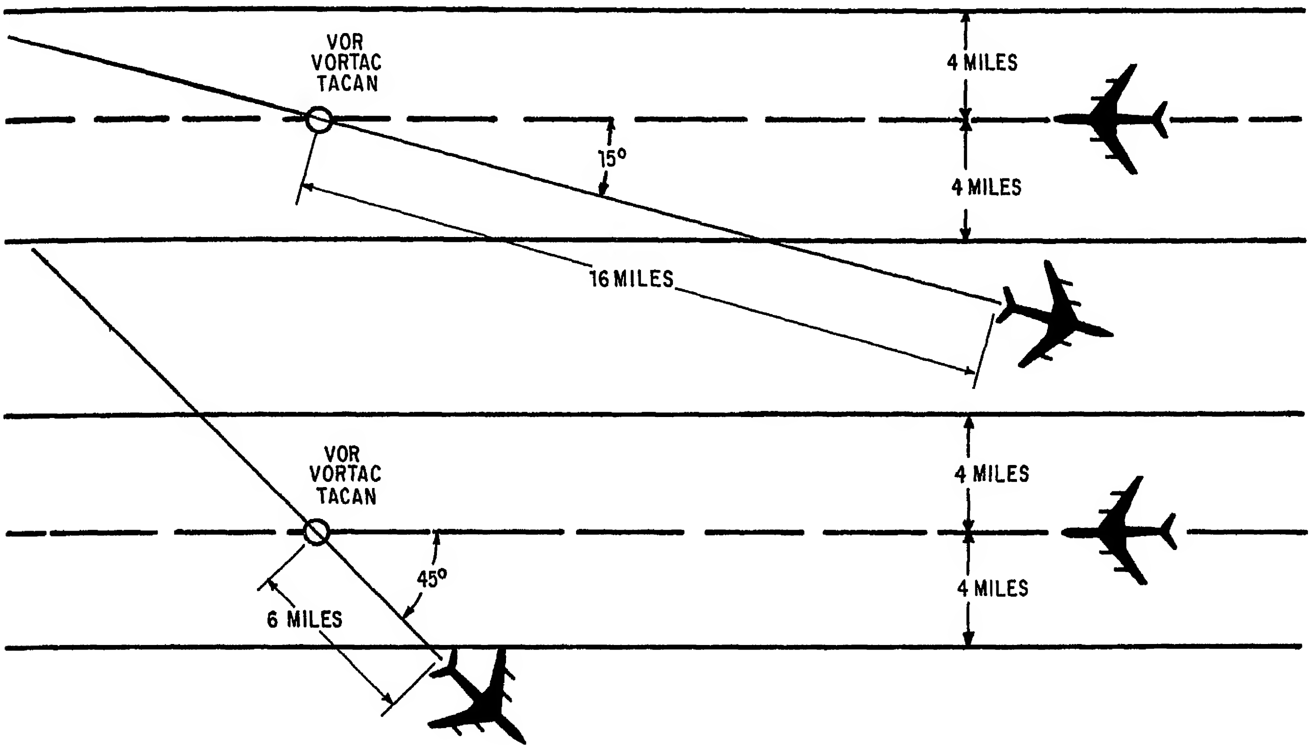
a. Below FL 180—same as paragraph 1.

b. FL 180 to FL 230 inclusive—28 miles.

c. Above FL 230 to FL 600 inclusive—34 miles.

4. After the course changes have been completed and the aircraft is back on course, the appropriate minima as specified in paragraph 1 apply.

5. For area navigation (RNAV) flights along other than established airways or routes utilizing



201.176

Figure 11-5.—Lateral separation using radials of the same NAVAID.

degree/distance fixes, the width of the protected airspace is ten miles each side of the route for flight above FL 450.

RNAV flights along other than established airways or routes using degree/distance fixes at FL 450 and below are provided radar separation.

Lateral DME separation can be achieved by requiring aircraft that are using DME to fly an arc about a NAVAID at a specified distance using the following minima:

1. Between different arcs about a NAVAID regardless of the direction of flight:

a. At 35 miles or less from the NAVAID—10 miles. (See figure 11-7.)

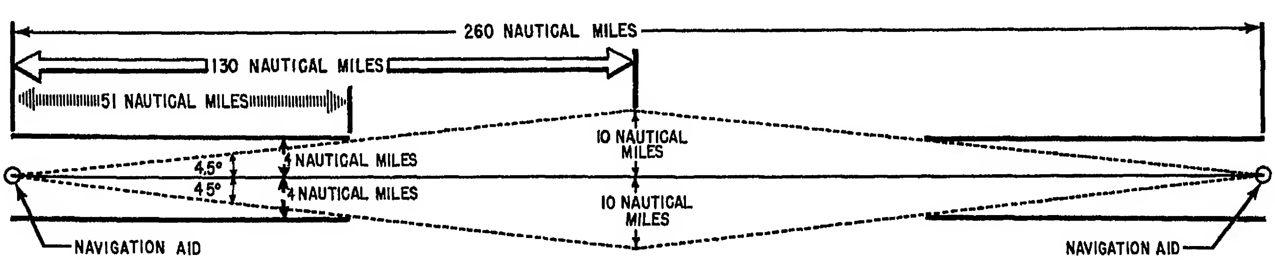


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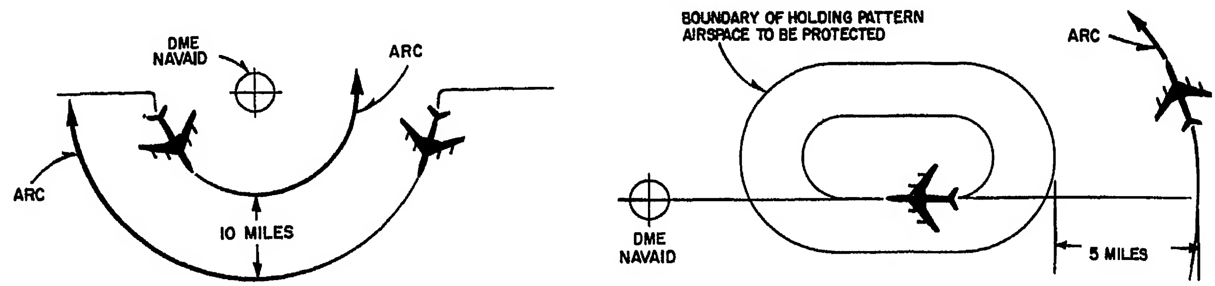
Figure 11-6.—Airspace protected for other thaqn established routes or airways.



201.177

Figure 11-7.—Lateral DME separation.

b. More than 35 miles from the NAVAID—20 miles.

2. Between an arc about a NAVAID and other airspace to be protected, such as a holding pattern, airway or route, warning area, etc.:

a. At 35 miles or less from the NAVAID—5 miles. (See figure 11-7.)
b. More than 35 miles from the NAVAID—10 miles.

En route Altitude Changes

Traffic conditions and other factors often dictate that en route traffic make altitude changes. When this is necessary and vertical separation is discontinued, another type of separation must exist until the proper vertical separation is reestablished.

Our purpose in the following discussion is to explain the procedures that are used to effect altitude changes for en route aircraft. But remember, before authorizing an altitude change, ensure that at least the applicable minimum vertical separation will exist after the change is completed. Certain standards of separation must exist when the aircraft making the altitude change crosses the altitude level of another en route aircraft. The minimums required at the time altitude levels are crossed depend upon whether the aircraft involved are flying the same or opposite directions. We will discuss the minimums applied for the same direction traffic first.

SAME DIRECTION TRAFFIC.—When lateral separation can be provided between two aircraft which require an altitude change, the problem of separation is not too great. When lateral separation cannot be provided, longitudinal separation minimums must be applied at the time altitude levels are crossed. Unless mentioned otherwise, before these minimums can be applied, the leading aircraft must be the aircraft descending, or the following aircraft must be the aircraft climbing (down in front and up in back).

When both aircraft involved are using DME, the minimum DME separation authorized is ten miles. This DME separation must exist between the aircraft when one of the aircraft crosses the altitude of the other during a climb or descent maneuver. Figure 11-8 shows this 10-mile DME separation being used to effect an altitude change for both a leading and a following aircraft.

If the conditions required for use of the 10-mile DME separation cannot be met, a 5-minute longitudinal separation can be used, provided certain other conditions exist. This 5-minute longitudinal separation is required between the aircraft when one of the aircraft crosses the altitude of the other during a climb or descent maneuver. Before the 5-minute separation standard can be applied, the involved aircraft cannot be separated by more than 4000 feet when the altitude change commences. Also, the change must commence within ten minutes after a following aircraft reports over, or acknowledges a specified time to cross, the same fix that a leading aircraft has reported passing.

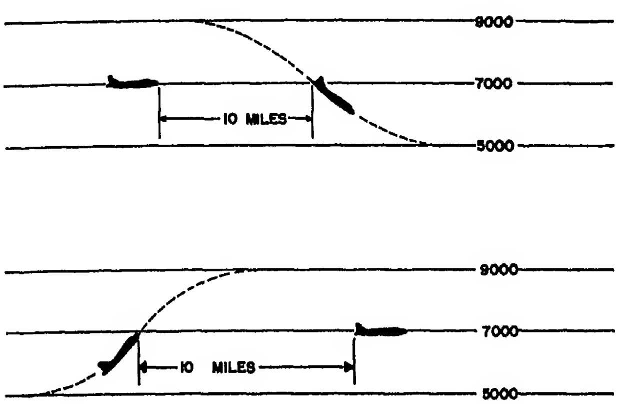


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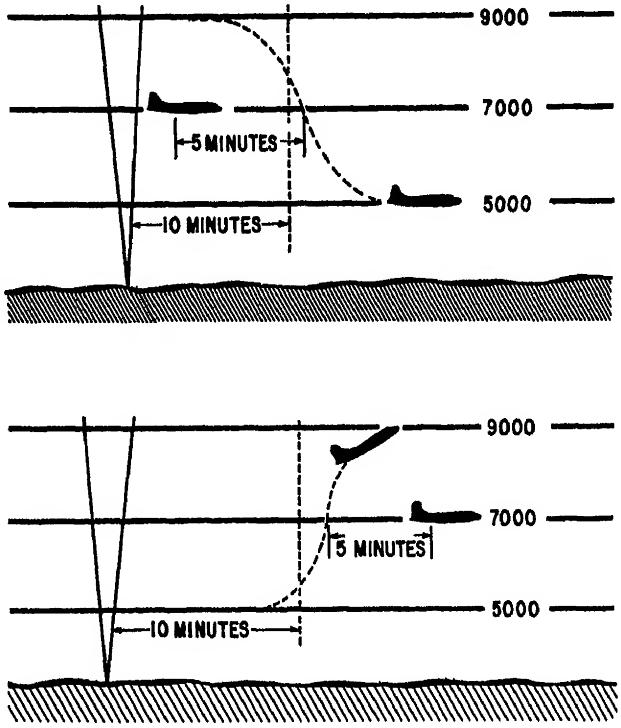
Figure 11-8.—Same direction altitude change using DME.

Figure 11-9 shows this 5-minute separation being used to effect an altitude change for both a leading and a following aircraft.

In some traffic situations, none of the preceding requirements to effect an altitude change for same direction traffic can be met. When this occurs, the DME separations are increased to 20 miles for aircraft using DME. The longitudinal separations are increased to ten minutes for all other aircraft.

OPPOSITE DIRECTION TRAFFIC.—Aircraft flying on courses which are in direct opposition to each other are considered to be opposite direction traffic. Aircraft on such courses must be separated from each other by standard vertical separation minima. Vertical separation must be maintained from a point ten minutes before until ten minutes after the time the aircraft are estimated to pass each other. Figure 11-10 shows an example of an altitude change being made between opposite direction traffic. When vertical separation has been provided and both aircraft report passing a NAVAID or DME fix, indicating that they have passed each other, vertical separation may be discontinued. Vertical separation may also be discontinued if both aircraft have reported passing the same intersection, and the aircraft are at least three minutes apart.

All of the specific longitudinal and lateral separations applied between aircraft conducting



201.172
Figure 11-9.—Same direction altitude change.

flight by area navigation (RNAV) were not included in our discussion. However, RNAV aircraft are separated in a similar manner. For example, the separations and conditions specified in our discussion relating to time and DME separations are also applicable to RNAV operations. For complete information with reference to RNAV aircraft separation minimums, study the FAA handbooks.

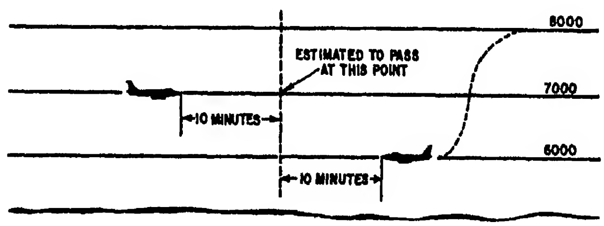


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Figure 11-10.—Opposite direction altitude change.

EXERCISE

11-15. A60148, a C-141, is maintaining a true airspeed of 385 knots at FL 310 along J-24, and AG01, an F-14, is also at FL 310 and tracking J-24. If A60148 reports passing the Pelston VORTAC at 1030, what is the earliest time AG01 could pass the same VORTAC?

11-16. Aircraft A is cleared to fly an arc of 20 miles DME south about a certain VORTAC. Aircraft B is approaching the same NAVAID at the same altitude and you desire that aircraft B also arc the NAVAID to the south. What two arcs from the NAVAID could you direct aircraft B to fly and have minimum lateral separation?

11-17. A99898, true airspeed 320, is flying on V-240 and reported over the Delta VORTAC at 0653 at FL 190. V21854, true airspeed 280, is also at FL 190 and flying on V-13, an airway which crosses V-240 at the Delta VORTAC. What is the minimum DME separation which must exist between the two aircraft at the VORTAC if both aircraft are using DME?

11-18. If Aircraft A is descending from 10,000 to 7000 feet and Aircraft B is following A on the same airway and level at 8000 feet, how many minutes separation are required between the two at the time Aircraft A passes 8000 feet if neither has reported a fix in 30 minutes?

11-19. In exercise 11-18, if DME were used, what would be the separation in miles?

11-20. If two aircraft are approaching the same fix and are vertically separated from each other, at what point may vertical separation be discontinued?

DEPARTURE PROCEDURES

Learning Objective: **For given situations, identify the initial separation standards applicable to arriving and departing aircraft.**

Initial Separation of Successive Departing Aircraft

Initial separation between successive departing aircraft may be considered an interim measure to expedite departures. As a controller you must plan ahead to ensure that the initial separation applied will allow a smooth transition to at least minimum vertical, longitudinal, or lateral separation when the initial departure phase of the flight is complete.

Aircraft that will fly courses which diverge by 45° or more after departing the same or adjacent airports may be separated by use of one of the following minimums:

1. Between aircraft departing from the same runway. (See figure 11-11.)

a. One minute until courses diverge when the aircraft will fly diverging courses immediately after takeoff.

b. Two minutes until courses diverge when the aircraft will fly the same course initially but will fly diverging courses within five minutes after takeoff.

c. Three miles until courses diverge when aircraft using DME will fly the same course initially but will fly diverging courses within 13 miles after takeoff.

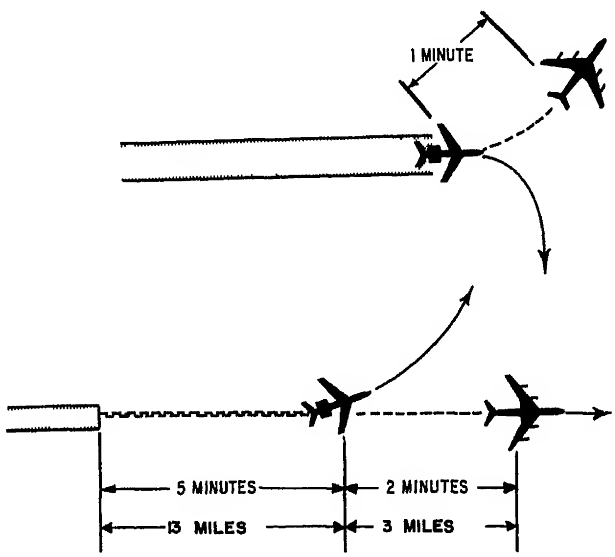

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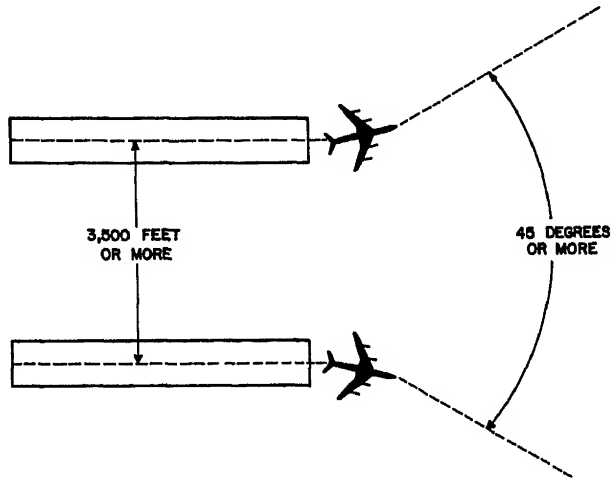
Figure 11-11.—Separation of departing aircraft using the same runway.



201.180
Figure 11-12.—Simultaneous takeoffs from parallel runways.

2. Simultaneous takeoffs may be authorized when aircraft will fly diverging courses immediately after takeoff in the same direction from different runways whose centerlines are parallel and separated by at least 3500 feet. (See figure 11-12.)

3. Simultaneous takeoffs may be authorized from diverging, non-intersecting runways when aircraft will fly diverging courses immediately after takeoff and either of the following conditions exist:

a. The runways diverge by 30° or more.

b. The distance between runway centerlines at and beyond the points where takeoffs begin is at least:

(1) 2000 feet and the runways diverge by 15° to 29° inclusive.

(2) 3500 feet and the runways diverge by less than 15°. (See figure 11-13.)

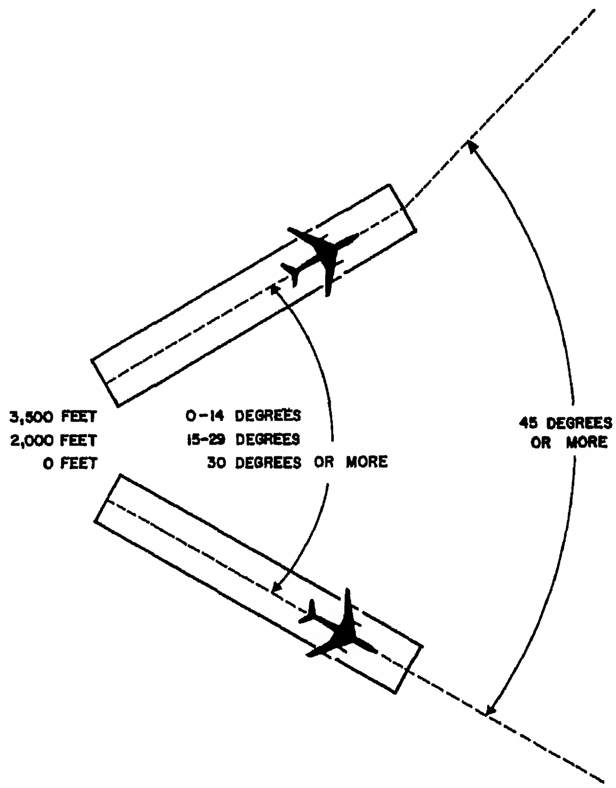


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Figure 11-13.—Simultaneous takeoffs from diverging runways.

4. On intersecting runways, a succeeding aircraft may be authorized to take off when the

preceding aircraft has passed the point of runway intersection and the following conditions are met:

a. The runways diverge by 30° or more.

b. The runways diverge by 15° to 29° inclusive and the preceding aircraft has commenced a turn. (See figure 11-14.)

Aircraft that will fly the same course, when the following aircraft will climb through the altitude assigned to the leading aircraft, may be separated by a minimum of three minutes until the following aircraft passes through the altitude of the leading aircraft. The minimum separation is five miles if both aircraft are using DME. (See figure 11-15.)

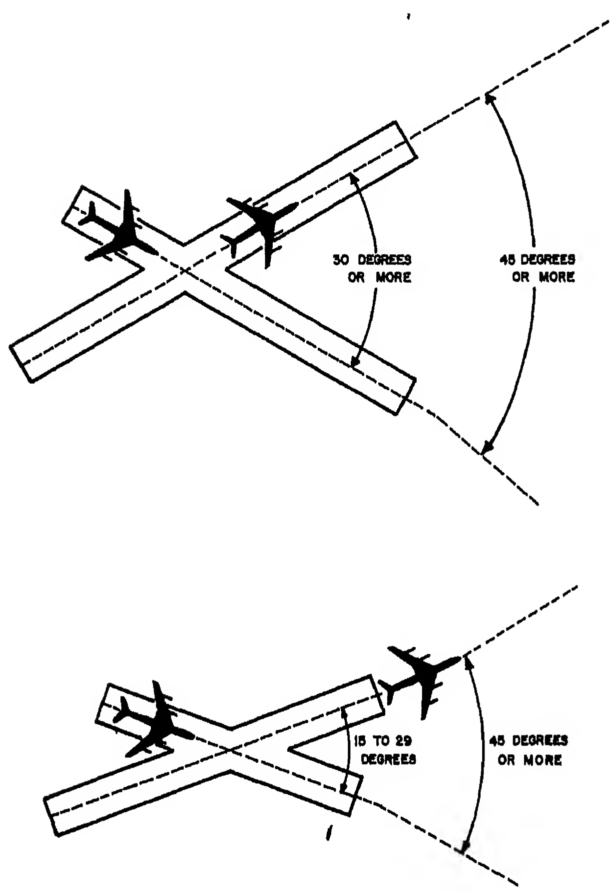

Figure 11-14.—Takeoffs from intersecting runways.

INITIAL SEPARATION OF DEPARTING AND ARRIVING AIRCRAFT

At airports where approach control service is provided, a departing aircraft may be separated from an arriving aircraft making an instrument approach to the same airport by using one of the following minima until vertical or lateral separation is achieved:

1. When takeoff direction differs by at least 45° from the reciprocal of the final approach course, the departing aircraft must take off before the arriving aircraft leaves a fix inbound not less than four miles from the airport.

2. When the takeoff direction does not differ by as much as 45° from the reciprocal of the final approach course, the departing aircraft must take off so that it is established on a course diverging by at least 45° from the reciprocal of the final approach course before the arriving aircraft leaves a fix inbound not less than four miles from the airport.

When the absence of an appropriate fix precludes the use of initial separation described in the preceding paragraph, and at airports where approach control service is not provided, a departing aircraft may be separated from an arriving aircraft making an instrument approach at the same airport by using one of the following minima until vertical or lateral separation is achieved:

1. When takeoff direction differs by at least 45° from the reciprocal of the final approach course, the departing aircraft must take off three minutes before the arriving aircraft is estimated at the airport. (See figure 11-16.)

2. When the takeoff direction does not differ by as much as 45° from the reciprocal of the final approach course, the departing aircraft must take off so that it is established on a course diverging by at least 45° from the reciprocal of the final approach course five minutes before the arriving aircraft is estimated at the airport or before the arriving aircraft starts its procedure turn. (See figure 11-16.)

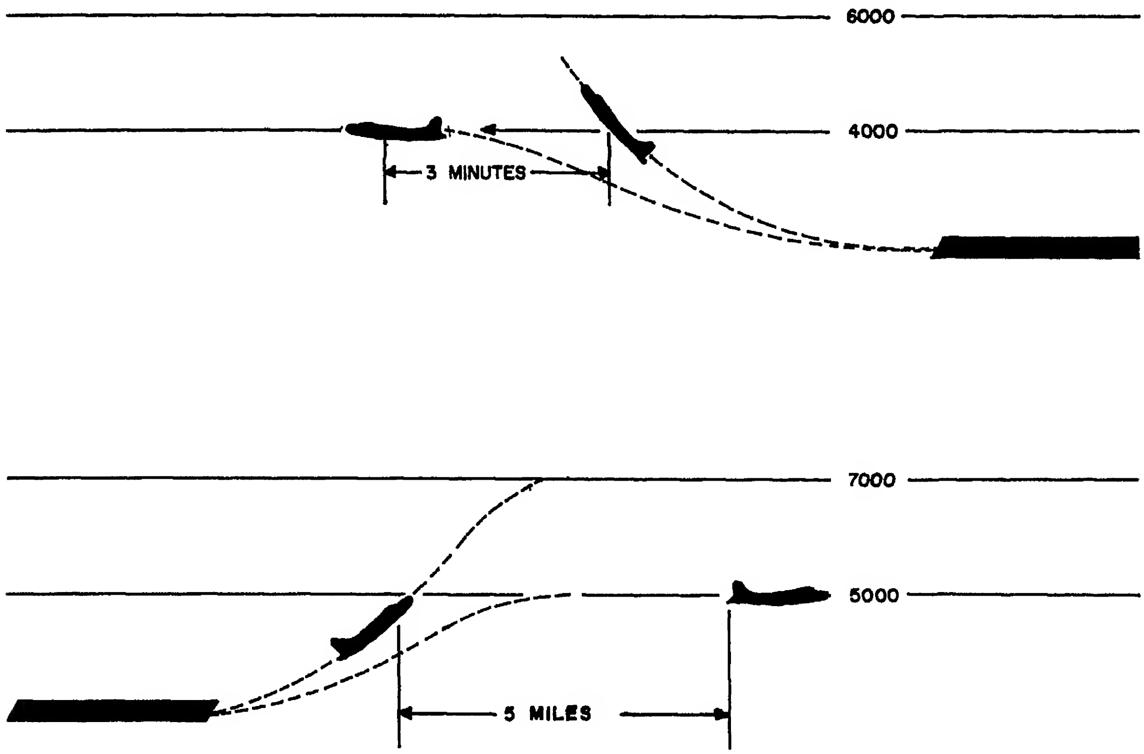

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Figure 11-15.—Takeoffs from the same runway when the succeeding aircraft climbs to the higher altitude.

EXERCISE

11-21. If two aircraft are to depart simultaneously from separate runways, by how many degrees must the runways diverge if no other method of separation is used?

11-22. What is the minimum separation, in minutes, between two aircraft which will follow the same course after departure if the following aircraft will climb to the higher altitude?

11-23. In exercise 11-22, what would be the minimum separation if DME were used?

11-24. In what instance would a 1-minute separation between departing aircraft be applicable?

11-25. What are the two conventional methods used to separate arriving and departing aircraft?

11-26. If an aircraft is on approach to runway 27, and a departure will depart from runway 27, at what point should the departure hold for the arrival?

11-27. Assume that aircraft A is departing from runway 18 and aircraft B is on approach to runway 03 and is estimated to be four minutes from the airport. If aircraft A is given an immediate left turn to 160°, may aircraft B be cleared for takeoff? Explain.

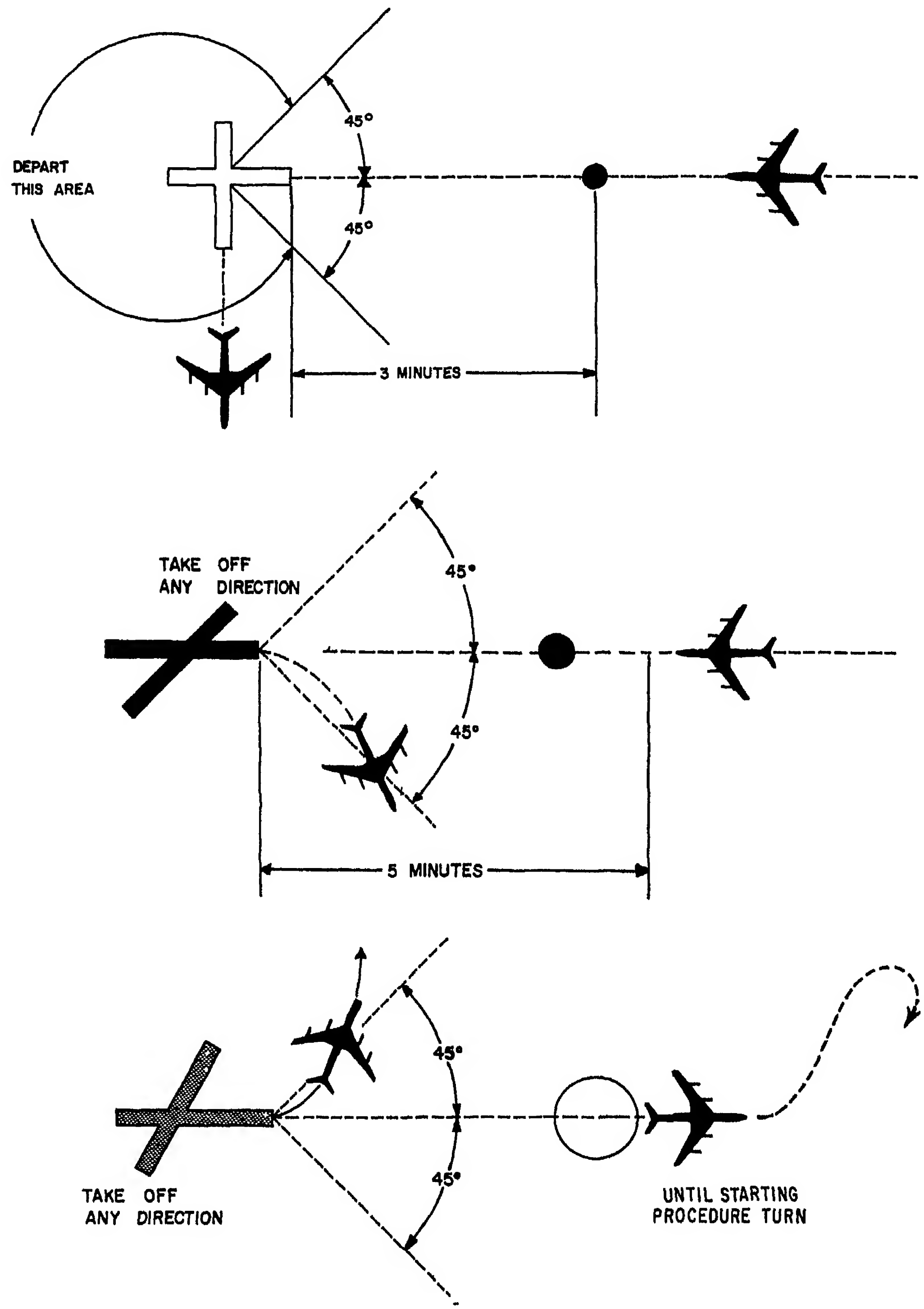

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Figure 11-16.—Separating departures from arrivals.

SPECIAL PROCEDURES

-earning Objective: **Identify Special VFR ınd other special related procedures.**

UAL SEPARATION

Tou may separate aircraft within control zones ›ne of the following methods:

'. You can see them and can provide visual ıration.

:. The pilot sees the other aircraft and says vill maintain visual separation from it.

n addition, a nonapproach control tower may authorized to provide visual separation veen:

. An arriving and a departing IFR aircraft n the tower has the arrival in sight.

EXAMPLE PHRASEOLOGY: RELEASE IJECT YOUR DISCRETION WHEN (air-t identification) IN SIGHT.

:. Successive departures when the weather is r above VFR minima (100/3).

:. Arriving IFR aircraft within control zones n the weather is at or above basic VFR minima the tower has reported that it has the aircraft ght and visual separation can be applied.

: OF VFR AND VFR NDITIONS ON TOP

Tou may clear an aircraft to maintain VFR litions when conducting flight under instru-t flight rules if one of the following condi-s exists:

l. The pilot requests such a clearance.

2. The clearance results in noise abatement benefits where part of the IFR departure route does not conform to an approved noise abatement route or altitude.

3. The pilot requests a practice instrument approach and is not on an IFR flight plan.

EXAMPLE PHRASEOLOGY: MAINTAIN V-F-R CONDITIONS UNTIL (Time or fix). CLIMB/DESCEND IN V-F-R CONDITIONS BETWEEN (Altitude) AND (Altitude). CLIMB/DESCEND IN V-F-R CONDITIONS ABOVE/BELOW (Altitude).

You may clear an aircraft to maintain VFR conditions on top of a cloud, haze, smoke, or other meteorological formation if the following conditions are met:

1. The pilot requests such a clearance.

2. The pilot is informed of the reported height of the top of the meteorological formation or that no report is available.

However, do not issue a VFR conditions-on-top type clearance when pilot reports indicate weather conditions are not suitable for such flight, or between sunset and sunrise to separate holding aircraft from each other or from en route aircraft unless restrictions are applied to ensure the appropriate IFR vertical separation.

An alternative clearance must be issued to aircraft cleared to maintain VFR conditions when there is reason to believe that flight in VFR conditions may become impracticable, or to an aircraft cleared to maintain VFR conditions on top when the height of the tops is unreported. As you learned in chapter 2, a VFR or VFR condition-on-top type clearance may not be issued to aircraft operating in positive controlled airspace.

Aircraft that operate VFR conditions-on-top must maintain a VFR cruising altitude/flight level. If you become aware that an aircraft on such a clearance is not at an appropriate VFR altitude for the direction of flight, you should inform the pilot of the discrepancy and advise him of a correct altitude for his direction of flight.

Appropriate VFR altitudes for direction of flight are listed in table 11-1.

No ATC separation is provided for IFR flights operating in accordance with a VFR condition restriction.

SPECIAL VFR CONDITIONS

Except where prohibited by FAR 93.113, authorize Special VFR operations only on pilot request and only within control zones on the basis of weather conditions officially reported at the airport of intended operations. If weather conditions are not reported at that airport, authorize Special VFR whenever the pilot advises he is unable to maintain VFR and requests Special VFR.

PHRASEOLOGY: CLEARED TO ENTER/OUT OF/THROUGH CONTROL ZONE, MAINTAIN SPECIAL V-F-R CONDITIONS WHILE IN CONTROL ZONE.

Fixed Wing (FW) Operations

PRIORITY.—Control zones other than those specified in FAR 93.113:

1. FW/SVFR flights may be approved only if arriving and departing IFR aircraft are not delayed.
2. When clearance cannot be granted for a FW/SVFR flight because of IFR traffic, inform the aircraft of the anticipated delay. Do not issue expect further clearance (EFC) or expected departure time.

PHRASEOLOGY: EXPECT (number) MINUTES DELAY.

CLIMB TO VFR.—Authorize an aircraft to climb to VFR upon request if the only weather limitation is restriction to visibility.

PHRASEOLOGY: CLIMB TO V-F-R WITHIN THE CONTROL ZONE/WITHIN (a specified distance within control zone) MILES FROM (airport name) AIRPORT, MAINTAIN SPECIAL V-F-R CONDITIONS UNTIL REACHING V-F-R.

Table 11-1.—Appropriate VFR altitudes for direction of flight

Magnetic course	Altitude	Interval
0°-179°	FL 290 and above	4,000 feet commencing with FL 300 EXAMPLE: FL 300, FL 340
0°-179°	More than 3,000 feet above the surface to but not including FL 290	"Odd" cardinal altitudes plus 500 feet EXAMPLE: 3,500, 5,500, FL 255
180°-359°	FL 290 and above	4,000 feet commencing with FL 320 EXAMPLE: FL 320, FL 360
180°-359°	More than 3,000 feet above the surface to but not including FL 290	"Even" cardinal altitudes plus 500 feet EXAMPLE: 4,500, 6,500, FL 265

LOCAL OPERATIONS.—Authorize local Special VFR operations for a specified period (series of landings and takeoffs, etc.) upon request, if the aircraft can be recalled when traffic or weather conditions require. Where traffic density and complexity of operations warrant, Letters of Agreement may be consummated with the local FSS, nonapproach control tower, airport manager, or local operator.

PHRASEOLOGY: LOCAL SPECIAL V-F-R OPERATIONS IN THE IMMEDIATE VICINITY OF (airport name) AIRPORT ARE AUTHORIZED UNTIL (time). MAINTAIN SPECIAL V-F-R CONDITIONS.

ALTITUDE ASSIGNMENT.—Do not assign a fixed altitude when applying vertical separation, but clear the Special VFR aircraft at or below an altitude which is at least 500 feet below any conflicting IFR traffic but not below the minimum safe altitude prescribed in FAR 91.79.

PHRASEOLOGY: MAINTAIN SPECIAL V-F-R CONDITIONS AT OR BELOW (altitude).

GROUND VISIBILITY BELOW ONE MILE.—When the ground visibility officially reported at an airport is less than one mile, treat requests for Special VFR operations at that airport by other than helicopters as follows:

1. Inform departing aircraft that ground visibility is less than one mile and that a takeoff clearance cannot be issued.

2. Inform arriving aircraft, operating outside of the control zone, that ground visibility is less than one mile and that, unless an emergency exists, a clearance cannot be issued.

3. Inform arriving aircraft, operating within the control zone, that ground visibility is less than one mile, and ask if the aircraft can depart the control zone with a flight visibility of at least one mile. If the reply is "yes," issue a clearance out of the control zone. If the reply is "no" or an emergency exists, issue a landing clearance as soon as traffic conditions permit.

4. Clear an aircraft to fly through the control zone if he reports flight visibility is at least one mile.

FLIGHT VISIBILITY BELOW ONE MILE.—When weather conditions are not officially reported at an airport and the pilot advises the flight visibility is less than one mile, treat requests for Special VFR operations at that airport by other than helicopters as follows:

1. Inform departing aircraft that a clearance cannot be issued.

2. Inform arriving aircraft operating outside of the control zone that a clearance cannot be issued unless an emergency exists.

3. Ask an arriving aircraft operating within a control zone if he can depart the control zone with a flight visibility of at least one mile. If the aircraft cannot depart the control zone accordingly, or an emergency exists, issue a clearance as soon as traffic conditions permit.

Helicopter SVFR Operations

Control a Special VFR helicopter by visual separation or SVFR procedures unless local procedures are contained in a Letter of Agreement.

The control of an IFR helicopter is the same as IFR or radar procedures and minima, unless other procedures are covered in a Letter of Agreement.

At locations where the volume or complexity of helicopter operations warrants, a Letter of Agreement must specify the fact that special VFR helicopters are required to maintain visual reference to the surface and the traffic patterns, routes, and reporting or holding fixes necessary to achieve appropriate separation. This separation is based on specific criteria and is as follows:

1. Between special VFR helicopters—one mile. You may, however, use 200 feet if they are

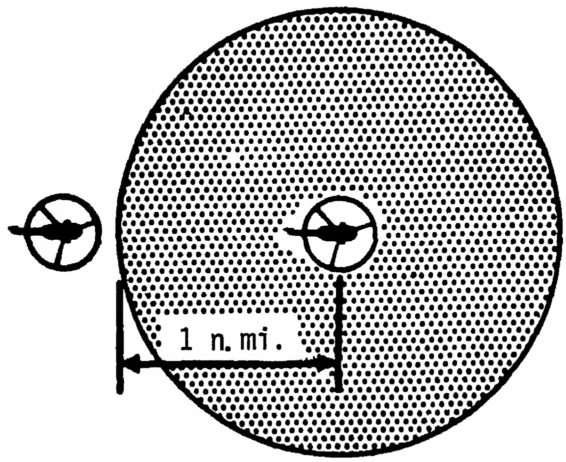

Figure 11-17.—Separation between SVFR helicopters.

departing simultaneously on diverging courses and you can determine this minimum by reference to the surface marking or you tell one to remain at least 200 feet from the other. (See figures 11-17 and 11-18.)

2. Between an arriving SVFR helicopter and an arriving FW/SVFR aircraft executing a straight-in approach:

a. If the FW/IFR is less than one mile from the landing threshold—1/2 mile. (See figure 11-19.)

b. If the FW/IFR is one mile or more from the landing threshold—1 1/2 miles. (See figure 11-20.)

3. Between an arriving FW/IFR aircraft executing a circling approach or a missed approach and an arriving SVFR helicopter—2 miles. (See figure 11-21.)

4. Between a departing FW/IFR aircraft and an SVFR helicopter:

a. If the fixed wing aircraft is less than 1/2 mile beyond the runway end—1/2 mile. (See figure 11-22.)

b. If it is 1/2 mile or more beyond the runway end—2 miles. (See figure 11-23.)

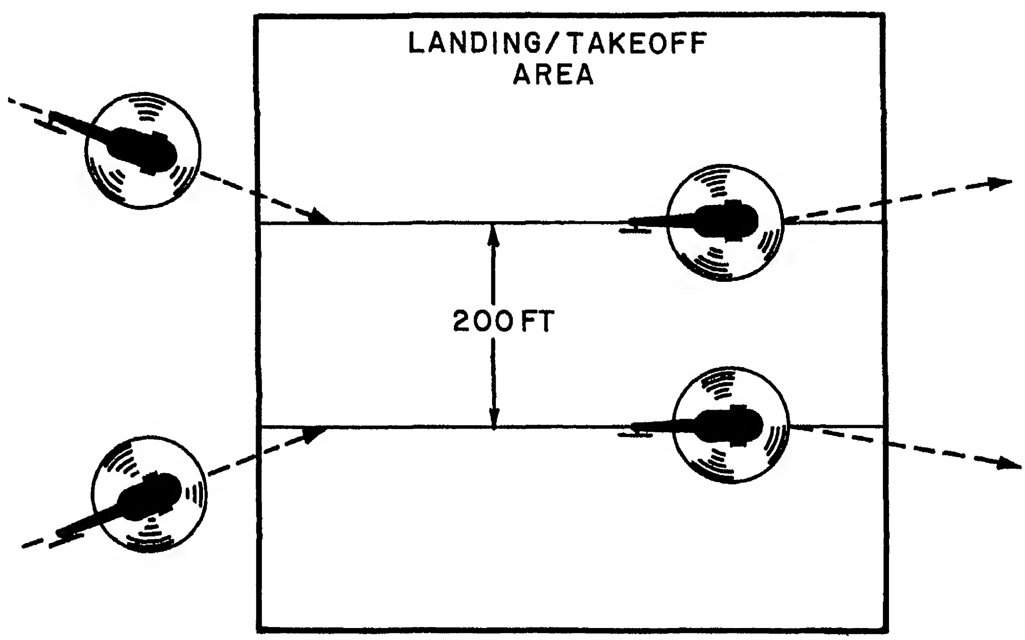

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Figure 11-18.—Separation of simultaneous helicopter operations.

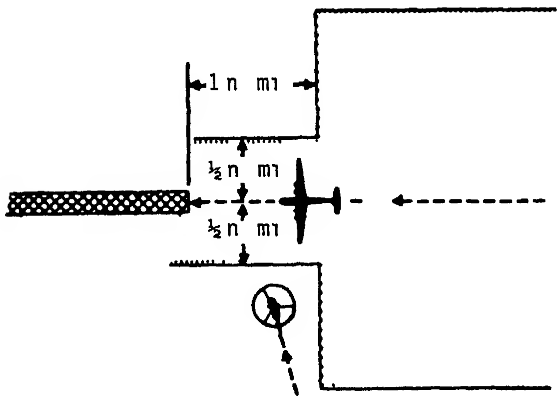
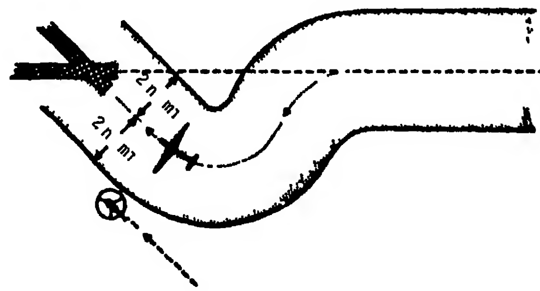


Figure 11-19.—Separation between an arriving Special VFR helicopter and an arriving fixed wing IFR aircraft executing a straight-in approach within one mile.

5. Between a departing SVFR helicopter and a departing FW/IFR aircraft—1/2 mile, if courses diverge after takeoff. (See figure 11-24.)

6. Between an arriving FW/IFR aircraft and an SVFR helicopter—sufficient separation to assure that the helicopter takes off on a diverging course before the arriving aircraft is one mile from the airport. (See figure 11-25.)



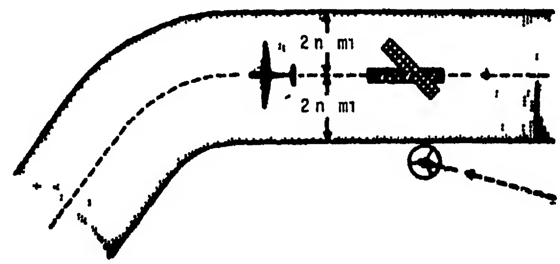


Figure 11-21.—Separation between an arriving fixed wing IFR aircraft executing a circling approach or a missed approach and an arriving Special VFR helicopter.

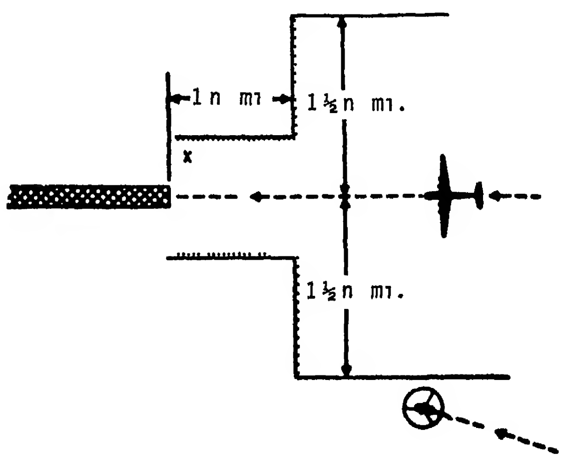


Figure 11-20.—Separation between an arriving Special VFR helicopter and an arriving fixed wing IFR aircraft executing a staight-in approach—one mile or more.

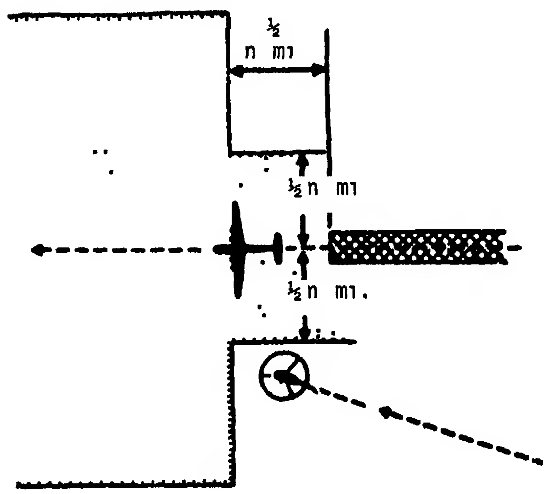


Figure 11-22.—Separation between a departing fixed wing IFR aircraft within 1/2 mile and a Special VFR helicopter.

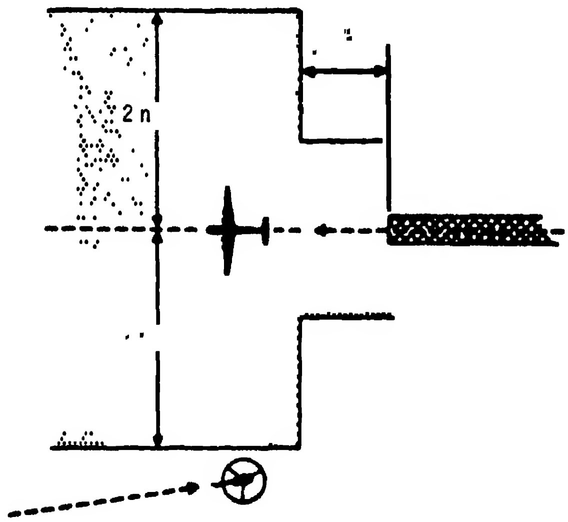


Figure 11-23.—Separation between a departing fixed wing IFR aircraft 1/2 mile or more from the runway and a Special VFR helicopter.

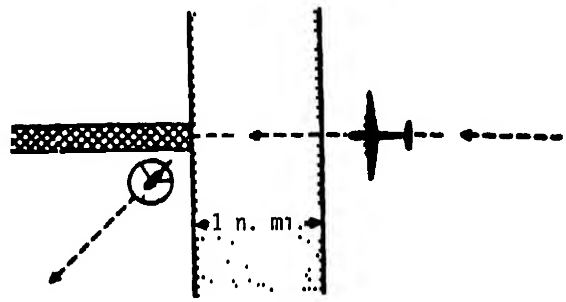


Figure 11-25.—Separation between an arriving fixed wing IFR aircraft and a Special VFR helicopter.

EXERCISE

11-28. What two methods are used to provide visual separation between aircraft within a control zone?

11-29. At a nonapproach control tower, what condition must be met for the tower to be authorized to apply visual separation between two departing IFR aircraft?

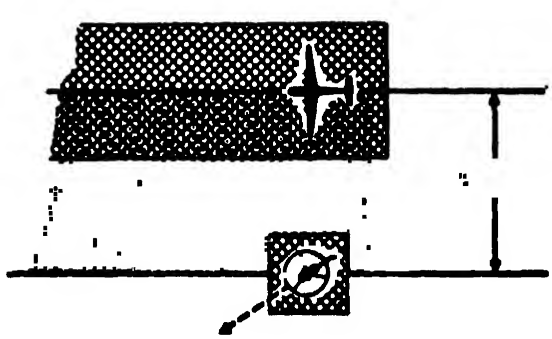


Figure 11-24.—Separation between a departing Special VFR helicopter and a departing fixed wing IFR aircraft when courses diverge after takeoff.

11-30. When may a VFR conditions-on-top clearance NOT be issued to an aircraft?

11-31. When IFR flights are operating in accordance with VFR condition restrictions, what IFR separation, if any, is applied?

11-32. What weather minima is/are required for special VFR operations?

11-33. You have IFR traffic flying through your control zone at 4000 feet. At what altitude should you clear an SVFR aircraft to MAINTAIN SVFR CONDITIONS AT OR BELOW ______ ?

11-34. What action should you take when the ground visibility is officially reported below one mile and an arriving aircraft

outside of the control zone requests SVFR clearance?

11-35. In the situation given in 11-34, what action should you take if the weather conditions are NOT officially reported?

11-36. What is the required separation between an arriving SVFR helicopter and a FW/IFR making a circling approach?

11-37. What is the required separation between departing FW/IFR aircraft and an SVFR helicopter when the FW/IFR aircraft is one mile from the runway end?

CHAPTER 12

RADAR PRINCIPLES AND ALLIED EQUIPMENT

The name RADAR is formed from the initial letters of the words Radio Detection And Ranging. In the late 1940s, radar was integrated into the air traffic control system. Since that time, many advancements have been made so that today's radar performs far better than was thought possible only a few years ago. Radar equipment is installed at almost all air bases throughout the Navy. It is, therefore, one of the tools of your trade.

Radar, as we know it today, can be traced back to two German scientists, Heinrich Hertz and Christian Hulsmeyer. The experiments conducted by these scientists were brought to the attention of Guglielmo Marconi who, in 1922, suggested that a practical application be made of the experiments conducted by the German scientists. Marconi envisioned this electronic marvel as a means of preventing collision between ships. His suggestion ultimately led to the development of radar.

During World War II, radar really arrived with recognition of its potential in detecting and ranging targets in wartime. This, of course, is still the primary purpose of military radar; however, the ability of radar to spot unseen objects has proven to be invaluable in the field of air traffic control. Civil and military aviation have grown to be a veritable giant compared to the days prior to World War II. The many departures and arrivals at major air terminals could not be as effectively and safely controlled without the assistance of radar. Previous separation standards can be reduced, and this contributes to the expeditious and orderly flow of air traffic without any compromise of safety. In fact, safety is increased in many situations. Radar is used in many ways but, in this chapter, our main concern is radar as applied in air traffic control.

Learning Objective: **State the principle upon which radar operates and the general function of major components of a typical radar set.**

FUNDAMENTALS OF RADAR OPERATION

Radar depends on a principle that energy emitted from one point and traveling at a uniform rate is reflected by obstructing surfaces in its path, in which case a small portion of the original energy returns, at the same rate of speed, to the point of origin.

This is the old principle of the echo, which we have all had demonstrated to us by sound waves. For example, when you shout at the side of a cliff to hear your echo, you are in effect, illustrating the basic principles of radar. However, you are using sound waves instead of radio waves. (See figure 12-1.) Radio waves that travel at the speed of light (162,000 nautical miles per second) also have echoes.

The nautical mile is used in this chapter because it is standard for navigation purposes, radar work, and when calibrating facilities.

In radar, the shout of our sound analogy is a short pulse from an ultrahigh frequency transmitter which sends out electromagnetic radio waves, and an object in the path of these waves reflects some of the radio energy. The reflected energy, or echo signal, is picked up by the

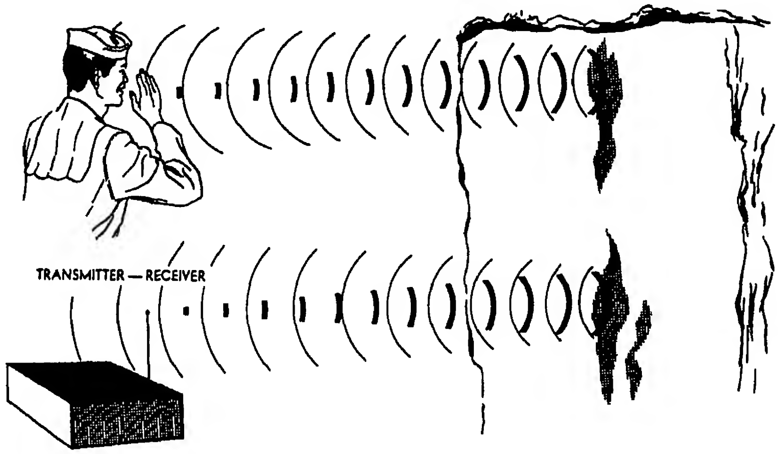


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Figure 12-1.—Reflection of sound and radio waves.

same antenna used by the transmitter and is fed to a receiver. The receiver amplifies the signal, changes it to a usable voltage, and feeds it to an indicator. The pulses sent out by the radar transmitter are generally of high power and extremely high frequency.

The signal pulse is repeated at definite time intervals. There is a very short period during which the transmitter sends out energy, and then a much longer period during which the receiver waits to pick up the reflected signals. The farther away the object, the longer it takes for the energy to reach the target and return. Because we know the time it takes to receive a reflection from an object and the speed at which pulses of radio energy travel, we can calculate the distance to an object. Because the energy travels to and returns from an object in straight lines, we also know the target's direction.

When each echo is received, the time between transmission and return of the echo is timed accurately and automatically. Instead of one signal pulse, radar uses hundreds of pulses per second and gets an indication of each reflected signal. Electromagnetic waves travel much faster than sound waves. The speed of radio energy is the same as that of light.

Such short time intervals must be measured electronically. A cathode-ray tube (CRT) indicator is generally used to display these measurements. At the time the pulse of radio energy is transmitted, a small spot of light starts to move at a uniform rate across the face of the indicator. If there is no echo (no object in the path of the radar pulse), the dot traces a line of uniform intensity on the face of the indicator. However, if a radar pulse is reflected, it causes the dot to be intensified and this momentarily brightens a short segment of the line. This process is repeated for each pulse sent out or returned. Echoes from the same object repeatedly brighten the same area, thus making a steady spot of light. Since the rate at which the dot travels across the indicator is known, the line of light, or sweep, can be marked off to represent the distance the pulse travels in that length of time. These marks (range marks) display the echo at a specific distance from the antenna.

The antenna, which radiates the pulses, rotates and shapes the energy into a narrow beam. As the antenna slowly rotates, an illuminated sweep line, from the center of the CRT to the outer edge and synchronized with the antenna, moves around the case of the CRT. Thus, the position of the spot of light (if there is a target echo) on the CRT shows both the direction (azimuth)

and the distance (range) of the target. Let us point out that the greater the range of a radar set, the slower the antenna rotates. This allows more time for the reflected return to travel the greater distance.

BASIC RADAR COMPONENTS

All radar sets have the same general basic components. Figure 12-2 shows a diagram of a simple radar set. (Part numbers used in this section refer to the number designation used in figure 12-2.) The heart of any radar unit is the synchronizer (2) or timing unit. It is here that a trigger voltage is developed and sent simultaneously to the modulator (3) and the sweep generator circuits (16). In the modulator section (3), the trigger voltage is transformed into a rectangular voltage pulse of extremely short duration and high amplitude. Therefore, the modulator determines the pulse width. At the same time, the sweep generator circuit (16) develops the voltage to produce the sweep on the indicator (15).

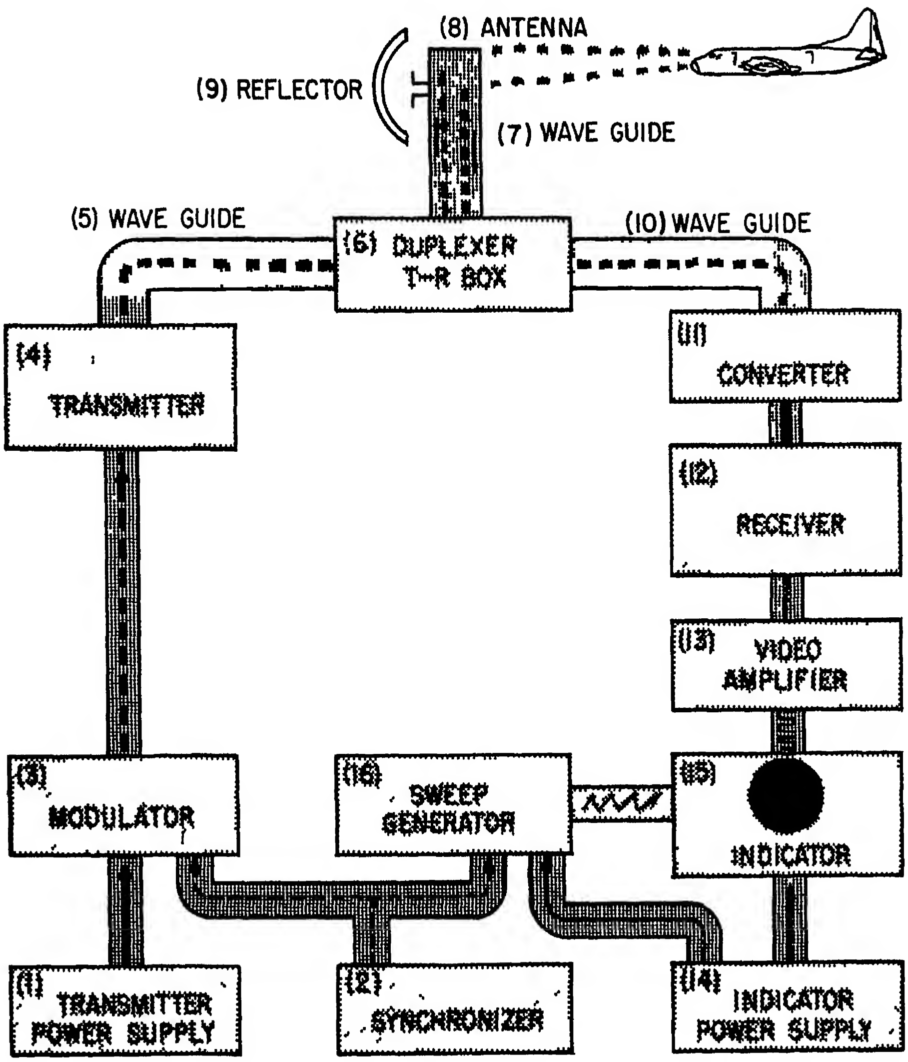

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Figure 12-2.—Basic components of radar system.

The high-voltage pulse from the modulator is fed to the transmitter. The transmitter (4) converts the d.c. pulses received from the modulator into extremely high frequency radio energy. Frequencies used in aviation radar are:

BAND	FREQUENCY	USE
S	1,550-5,200 MHz	Airport Surveillance Radar (ASR).
X	5,200-10,900 MHz	Precision Approach Radar (PAR).
L	390-1,500 MHz	Long Range Surveillance

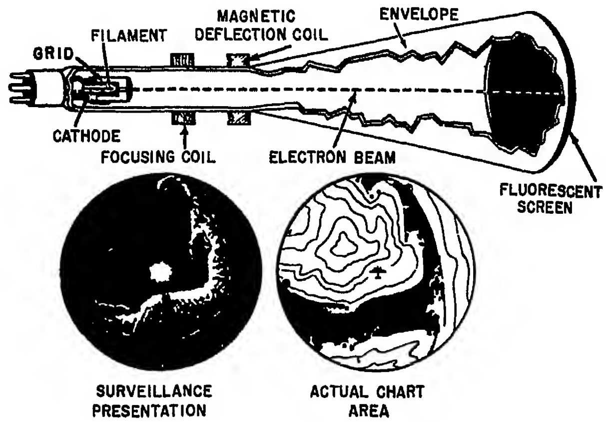

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Figure 12-3.—Cross section of cathode-ray tube with radar presentation.

The transmitter, generally a magnetron or a klystron, generates a burst of radio-frequency (RF) energy, which lasts as long as the pulse from the modulator is applied to the transmitter tube. This radar pulse is sent through a waveguide (5), a hollow rectangular conductor, to the antenna. The antenna (8) then radiates a beam into space. The beam's width and height are determined by the shape of the antenna reflector (9).

A special switching device, the duplexer or T-R box (6) allows the transmitter and receiver to use the same antenna. The duplexer prevents all but a very small part of the transmitter pulse from entering the receiver. As soon as the high-voltage pulse from the modulator ceases, the transmitter tube stops generating RF energy and waits for the next pulse from the modulator. The delay depends upon the maximum range for which the set is designed.

Objects in the path of the radiated energy reflect some energy (echoes) back to the antenna. The antenna sends the echoes to the receiver through the duplexer. The receiver (12) amplifies the signals and changes them to video pulses. The indicator (15) converts the video pulses received from the video amplifier (13) into light indications and presents this information in the desired form. Practically all indicators are based on the use of the cathode-ray tube (CRT). The CRT, or "scope," is a conical glass bulb with an electron gun at the small end and a flattened glass disc at the other end. Its basic construction is somewhat similar to a television picture tube. (See figure 12-3.)

Since the indicator measures the distance from the radar antenna to the target, the sweep must be marked off in some way to enable the operator to tell at a glance the location of the target. It takes a pulse 12.3 microseconds (μsec—1 millionth of a second) to reach a target 1 nautical mile away and return. Therefore, the time in μsec required for a pulse to reach a target and return, divided by 12.3 gives the range to the target in nautical miles. A pulse that requires 246 μsec to travel to a target and return is reflected from an object 20 miles from the radar antenna.

RADAR DISPLAY

There are numerous ways of displaying the radar data once it has been obtained. The manner of presentation depends upon the use to be made of the data. The most frequently used type of ASR presentation in air traffic control is a Plan Position Indicator, commonly referred to as the PPI-scope. In this type of display the time reference is at the center of the cathode ray tube face. Bearing information

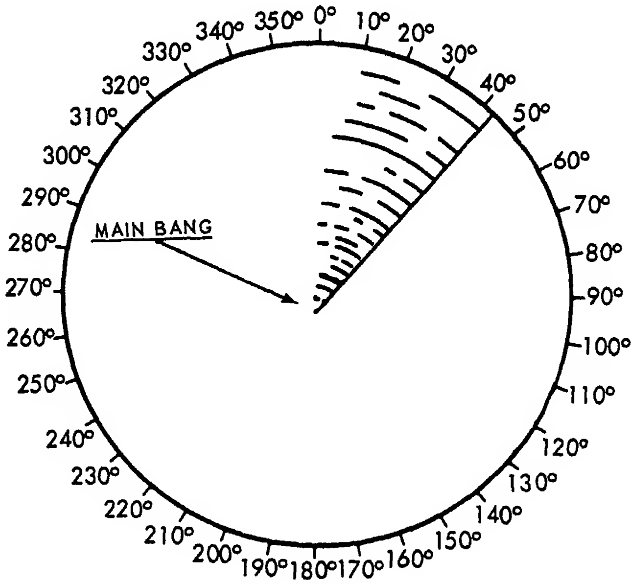

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Figure 12-4.—Compass rose.

is provided through the use of a compass rose. As shown in figure 12-4, the compass rose is a circular device which surrounds the PPI and depicts magnetic bearings from zero to 350 degrees in 10-degree increments. As you can see, ASR has 360 degrees of scan. Range information is provided through the use of rangemarks. Rangemarks are introduced into the system and show up as bright concentric circles on the display. Their spacing in terms of miles may be various values (1, 5, etc.), although at any one time the spacing will be uniform throughout the display.

The PPI-scope may be expanded for short ranges; for example, a 5-mile range may actually cover the same area on the face of the tube as a 30-mile range. The rangemark spacing interval may be of the type that produces a certain rangemark spacing interval for a specific range selected. There will be many occasions, particularly when making radar approaches, that you will use an off-centered scope. By moving the placement of the antenna sight (the "main bang") on the indicator, a greater area of airspace is seen in one direction. At the same time this diminishes the airspace area viewed in the opposite direction. If 30 miles were the greatest range on a range selector switch, it would be possible to extend the sweep out to 60 miles in any desired sector by off-centering to the edge of the tube face. Whether targets could be seen out to 60 miles depends on the radar system itself and the type of target. Figure 12-5 shows two PPI-scopes with the same range selected but with one off-centered to increase the area covered to the southeast.

You must remember that bearing and range information are relative to the main bang on the off-centered scope just as in a normal, centered, presentation. It should prove relatively simple to obtain bearing information when using the centered scope. Since the main bang is in the center of the surrounding compass rose, it may be used as a reference point until you become more familiar with bearing information. Because off-centering displaces the main bang from the center of the compass rose, you will have to imagine a 360° compass rose surrounding the main bang, wherever you have placed it on the scope.

In addition to range marks, some search indicators have angle marks. These are intensified sweep traces which outline the sector scanned by precision radar antennas. These traces enable you to guide an incoming aircraft into the area served by the precision radar.

The precision indicator is often called the AZ-EL indicator because it provides both azimuth

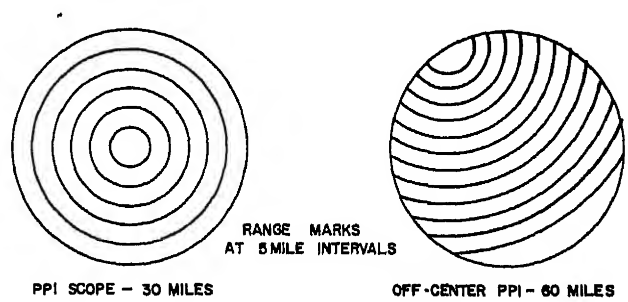

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Figure 12-5.—Advantage of off-center PPI-scope.

and elevation information. (See figure 12-6.) The sweeps, unlike those of the search indicator, do not move at a constant rate across the screen. Instead, the beam of electrons slows down as it advances, thus expanding the azimuth and elevation display near the sweep starting point. The sweep starts at a point near the left edge of the CRT in order to use a greater face area of the CRT. The fast rate at the beginning of the sweep provides increased range accuracy as the aircraft gets closer to the runway. One mile from the antenna, the PAR indicator has a range sensitivity and a left-right sensitivity five times greater than the search indicator. Range marks are vertical lines on the azimuth and the elevation sectors. On the azimuth sector, a bright line indicates the runway courseline; on the elevation sector, a bright line indicates the glidepath. These bright lines are commonly called cursors.

EXERCISE

12-1. Briefly state the principle upon which radar systems operate.

12-2. State the basic function of a radar system's "duplexer."

12-3. State the basic function of a radar system's "synchronizer."

12-4. What is the function of the "CRT" in a radar system?

RADAR HAZARDS

Learning Objective: **Name three hazards associated with radar sets and equipment and tell what you can do to avoid them.**

Because all radar sets operate on high voltage, the possibility of severe electrical shock or electrocution is always a potential hazard to operators. The most treacherous feature of electricity, particularly a high-voltage circuit, is that its presence cannot be detected by any of the human senses until it is too late—it cannot be seen, heard, tasted, or smelled. Every radar set that you will encounter has been tested, retested, and then tested again to assure that all of its equipment is properly grounded and safe for use. Any component that contains lethal voltage is clearly marked and protected against accidental access. In order to receive a severe electrical shock, you must do something careless.

Never attempt to adjust any part of your radar equipment if there is a possibility of receiving injuries from high-voltage components. Do not handle power cables or wires, and do not experiment with components or equipment that you have no business bothering. Trained maintenance personnel are always available to make the necessary adjustments. In many cases, even they will not start repairs until a qualified safety observer is present.

Most controllers are familiar with the safety hazard created by the high voltages found in radar equipment. However there is another safety hazard connected with the operation of radar equipment that is generally not known or understood by them. This hazard, electromagnetic radiation, you must recognize when working with, or in the vicinity of, radar systems. The scant radiation that you might receive from walking in front of a moving radar antenna is negligible. However, prolonged exposure to the direct radiated beam of a high-powered radar system can be extremely dangerous because of the thermal effect of electromagnetic radiation. When this energy is absorbed in tissues of the body, it produces heat. If the heat cannot be dissipated as fast as it is produced, the internal temperature of the body will rise. Organs such as the lungs, eyes, testicles, gallbladder, urinary bladder, and portions of the gastrointestinal tract are not cooled by an abundant flow of blood. Therefore, these organs are easily damaged by heat from excessive exposure to radiation. To protect yourself from this potential danger, never stand directly in front of a radiating radar antenna; you can't tell if your internal organs are being heated, and serious damage can be done before you know it.

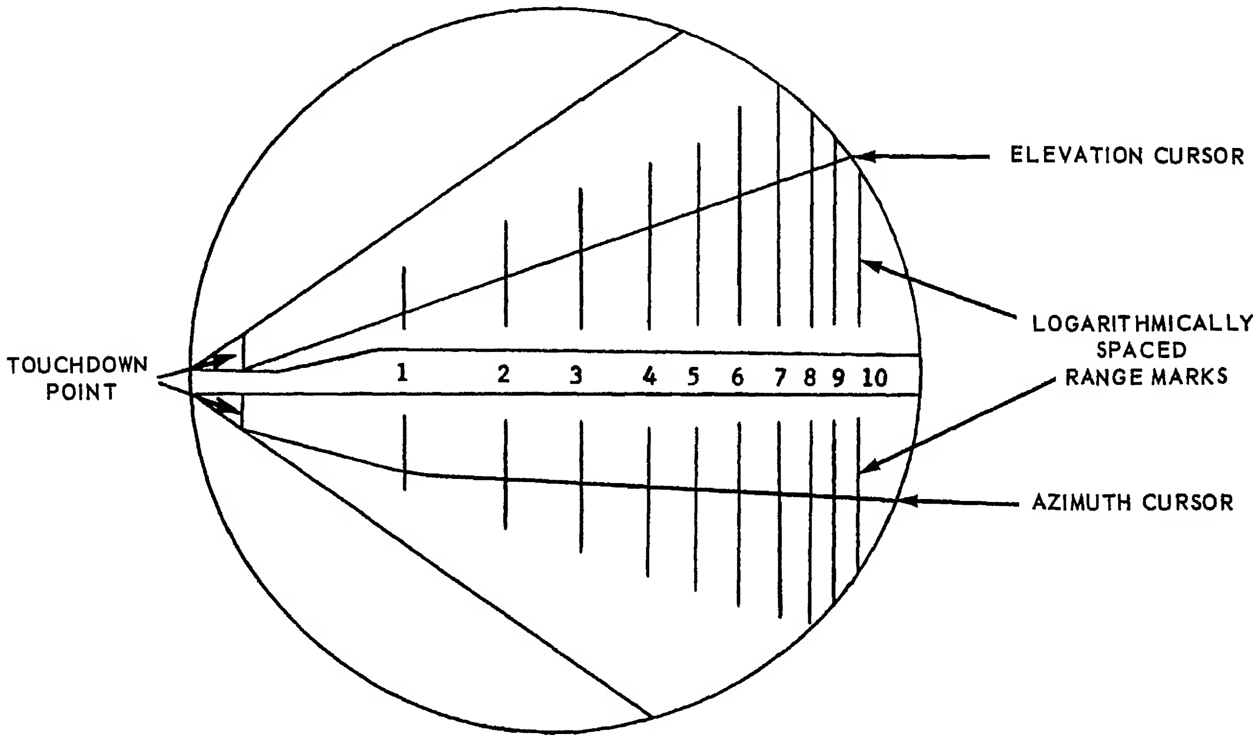

Figure 12-6.—PAR scope display.

Another potential hazard is the high vacuum present in radioactive cathode-ray tubes used in radar indicators. Although high levels of radioactivity are not normally present in the vicinity of these tubes, there is a great danger of implosion if a tube is damaged. These tubes, when broken, release radioactive material which can be inhaled, or can enter the body through an opening in the skin. To assure your safety, be particularly careful not to bump, crack, or scratch these tubes. As you begin to operate a particular radar set, your supervisor will provide you with a detailed briefing regarding components that are potentially dangerous and the safety practices that you must observe. Rest assured that you are in no danger while working with radar unless you become negligent.

EXERCISE

12-5. Name three hazards associated with radar sets and equipment.

12-6. For each of the three hazards that you listed, tell what you can do to prevent being subjected to these hazards.

SPECIAL CIRCUITS, EQUIPMENT, AND TOLERANCES

Learning Objective: **Identify capabilities, characteristics, and utilization of radar and its auxiliary circuits and equipment.**

A basic PPI display (see figure 12-7) shows all types of radar echoes—both fixed and moving targets. Ground targets, which are normally displayed as strong echoes, and weather echoes may mask echoes from aircraft flying over these areas. Any echo that is undesirable, or that

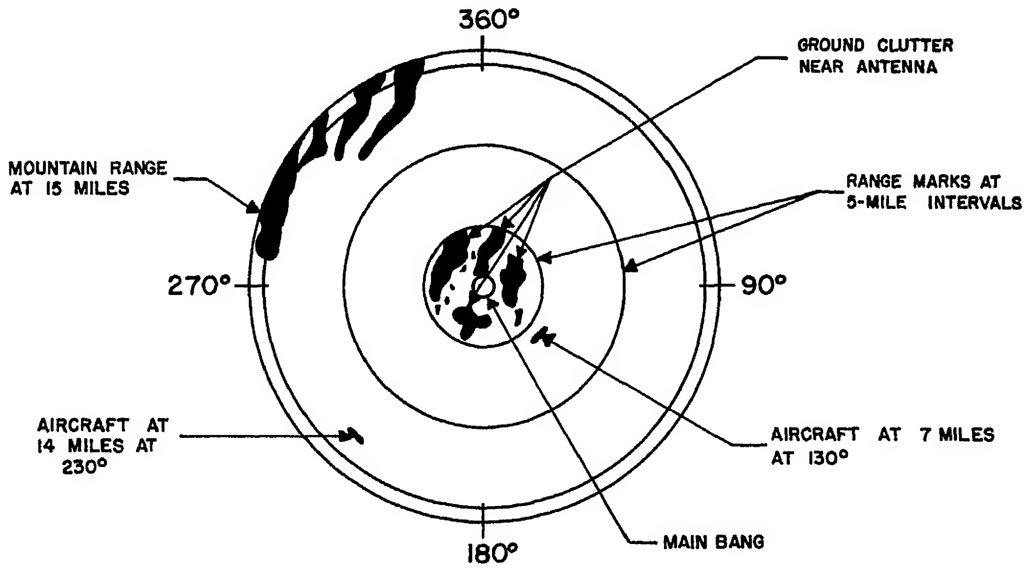

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Figure 12-7.—PPI-scope display.

prevents the controller from observing aircraft, is called clutter. Special circuits have been added to the basic radar components to eliminate or greatly reduce clutter

SPECIAL CIRCUITS

Automatic Frequency Control (AFC)

The first circuit we wish to discuss is a circuit which keeps the radar transmitter and receiver tuned to the same frequency. It is called the automatic frequency control (AFC). Various things cause the transmitter to change its output frequency. The receiver, too, may suffer from frequency drift. When the echo signal frequency differs from the receiver frequency, the AFC circuit makes use of the frequency difference to automatically retune the receiver or transmitter circuits. This allows the receiver to pass the echo signal voltage. Without AFC, many echo signals are lost. There is no adjustment of the AFC circuit for the operator to make.

Fast Time Constant (FTC)

Often, radar returns are affected by heavy precipitation during periods when radar is needed most. These returns block the receiver, so that no other target returns appear on the indicator. To combat these effects, many sets incorporate an FTC circuit. The fast time constant circuit changes long echo pulses to pulses of short duration. It thus serves to display only the leading edge of long-duration signal returns and allows small-target echoes to get through without change.

Sensitivity Time Control (STC)

Echoes returning from distant targets are much weaker than those from nearby objects. STC assures that targets appear with equal intensity on the indicator, regardless of range variation. The STC circuit provides maximum gain for distant targets and prevents blooming of targets nearer the antenna. At the beginning of the sweep, where ground clutter has the most effect, it makes the gain quite low.

Moving Target Indicator (MTI)

Large stationary objects such as trees, buildings, and mountains return a considerable amount of RF energy. This energy appears as

bright, stationary echoes on the indicator. Such echoes are objectionable because they clutter the indicator screen with unwanted signals and partially or complětely obscure useful signals.

Figure 12-8 is an example of a 20-mile PPI display with the MTI range adjusted to 10 miles and normal radar appearing beyond that. The lines on the scope in figure 12-8 comprise a mapping system discussed later in this chapter.

The MTI is able to distinguish between stationary and moving targets. The ability of the system to make this distinction depends on two principles: (1) the phase (time) difference between a transmitted pulse and its echo from a stationary target is constant from one pulse to the next: (2) the phase difference between a transmitted pulse and its echo from a moving target varies from one pulse to the next. By comparing the phase difference between one pulse and the next, it is possible to tell which echoes are from stationary targets and which are from moving targets. Then the stationary target echoes can be removed.

The least desirable characteristic of MTI is its radar cancellation speed, commonly referred to as blind speed. Blind speeds are caused by the phase detection method of canceling nonmoving targets. The result is that aircraft targets disappear at certain speeds in relation to the antenna location when only MTI is used. The aircraft need not be flying directly toward or away from the antenna nor must its ground speed be the same as a blind speed to cause target disappearance. Only the rate of closure or rate of departure, in relation to the radar antenna location, is important. For example, an aircraft passing through the area, but not coming within several miles of the radar antenna, might disappear several times from the scopes.

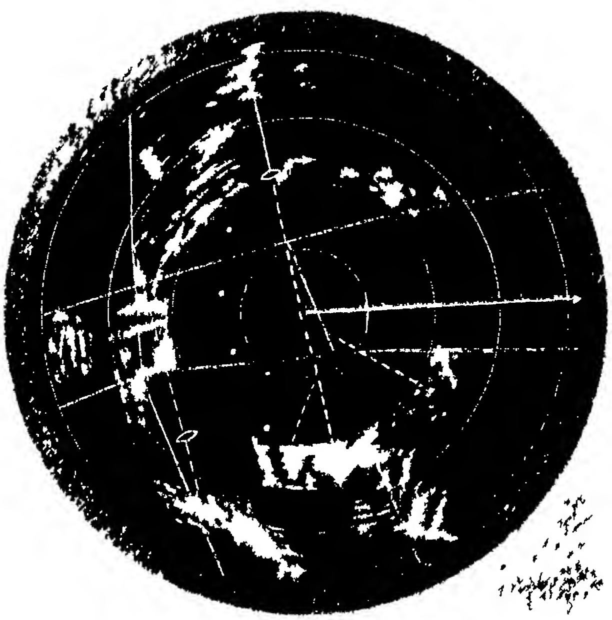

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Figure 12-8.—A 20-mile PPI display with MTI adjusted to 10 miles.

You should always expect the aircraft to disappear as it passes the antenna at its nearest point, such as on downwind where the aircraft is nearest the antenna. Also, the target is likely to disappear when the antenna is on the inside of the turn. The target disappears because the aircraft momentarily flies a perfect arc which results in zero knots radial velocity which is the blind speed.

Since blind speeds occur only when MTI is used, you should never completely cancel all ground targets when using radarscopes capable of mixing normal and MTI radar. Normal radar should be ghosted-in sufficiently to prevent target disappearance. This allows you to make rapid checks of scope alignment and see obstructions, high terrain, and corner reflectors.

ATC radars may vary in pulse repetition frequency (PRF). You may be working with equipment that has PRF staggering which eliminates blind speeds below approximately twice the speed of sound. Occasionally, your local radar transmitter frequency may be changed to eliminate or minimize interference from nearby radar transmitters.

Clutter-gated video

The clutter-gated video automatically switches from MTI to normal or from normal to MTI. The radar-receiving circuit automatically switches to MTI at any time a target over 1 millionth of a second (μsec) in duration is detected. Since aircraft targets vary between 0.7 and 1 μsec, the circuit provides a normal video presentation of aircraft targets only. However, ground returns or any combination of ground and aircraft returns are processed in the MTI mode. Thus, an aircraft

may approach a mountain while being presented on a normal display. As it flies over the mountain, it is presented on an MTI display. As it leaves the mountainous area, it is again presented on a normal display. This action is automatic. As soon as the equipment detects a target in excess of 1 μsec, it switches to MTI, remains on MTI through the cluttered area, then switches back to normal. Thus, a presentation of normal, MTI, and normal video may all occur on one sweep.

Clutter-gating is controlled by an ON-OFF switch. The controller also has three gain controls: MTI gain, normal gain, and clutter mix. The clutter mix control mixes clutter video with MTI video.

Circular Polarization

A factor that determines the effective range of radar is the manner in which the radar energy is radiated into space. The radiation of electromagnetic (radar) energy during normal weather conditions gives good target returns. However, during a heavy rainstorm, the individual raindrops act as targets and reflect the polarized electromagnetic energy which may completely illuminate or clutter the scope and obscure any target that may be in the area. This condition is undesirable and is overcome by radiating energy in a type of polarization that is designed to cancel returns from symmetrical targets, such as raindrops, while accepting returns from asymmetrical targets such as aircraft. This type of polarization is known as circular polarization.

Operator control of polarization is normally a two-position toggle switch labeled LP-CP (linear-circular polarization). LP is selected for normal operation, and CP is selected when necessary to reduce clutter from precipitation. Figure 12-9 shows a comparison of linear and circular polarization used in conjunction with MTI. MTI will eliminate some precipitation clutter, but normally precipitation is moving fast enough to be displayed as a moving target.

Caution should be exercised when using circular polarization. The CP will also reduce the target strength of aircraft targets and in some cases may eliminate it altogether.

SPECIAL EQUIPMENT

Mapping Systems

A radar controller uses the rangemarks on the PPI and the compass rose around the edge of the scope to obtain the position of an aircraft target. Information from these two sources gives only

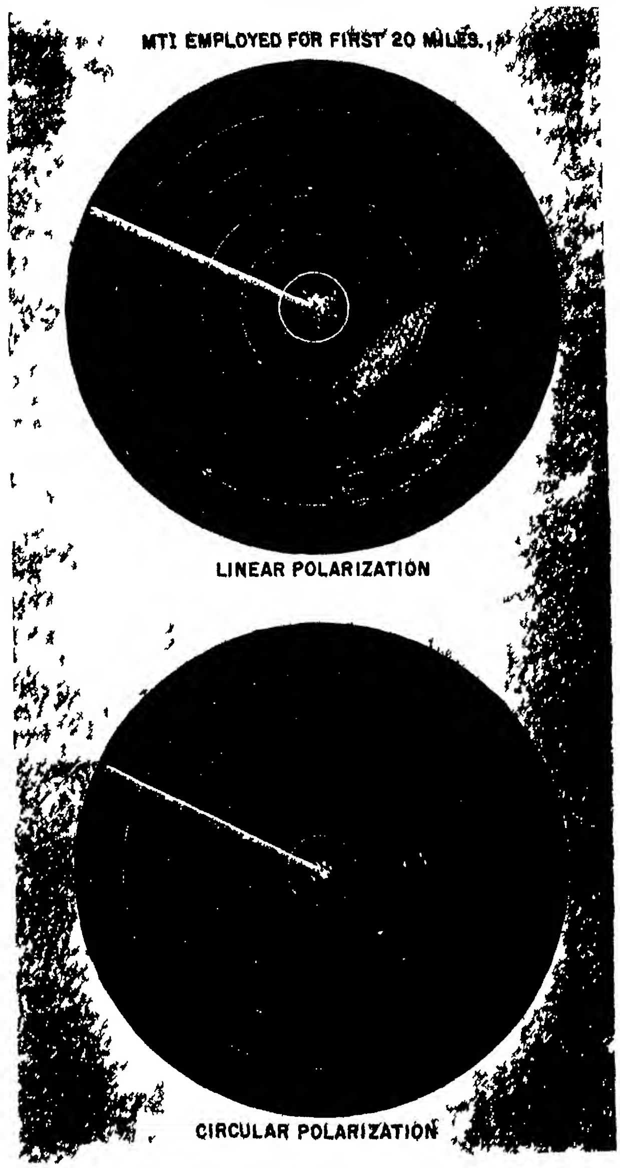

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Figure 12-9.—Comparison of linear and circular polarization with MTI employed.

range and azimuth from the radar antenna, and does not depict the geographical location of the aircraft; therefore, some type of map display would be advantageous. Two types of mapping are available as integral parts of a PPI—a map overlay and video mapping.

The simplest solution is the map overlay. As the name implies, it is installed so that it covers the face of the cathode-ray tube. The overlay is made of transparent plastic, and necessary reference marks, location of NAVAIDs, runways, and obstructions are etched into the surface. The overlay is edge-lighted, and you can control the brilliance. The shape of the overlay conforms to the surface of the CRT, but does not touch it.

There are two inherent disadvantages to the map overlay. Since the map is installed a short distance away from the tube, the targets do not appear in proper relation to the map unless you look at the target from a point directly above the target. This is called parallax. Targets apparently drift away from one of the etched courses, when your viewing position changes. You must be extremely careful of your posture, so that you can observe the target correctly and prevent parallax. The other disadvantage is that the map is only good for one range setting of the radarscope, since it does not expand with the display on the tube.

The video map is a great improvement over the map overlay. It is produced by a separate mapping unit rather than being installed on the radar console. A scale map with the desired features is drawn and then reproduced as a round photographic negative. This information is fed to the video amplifier ahead of the indicator tube and mixed with radar information from the receiver so that the resulting signals to the PPI will contain a combination of radar and map data. The antenna scan and the map scan are synchronized so the map is developed directly on the PPI as the sweep progresses. The result, and biggest advantage of the video map, is that the map expands or contracts as the range of the indicator is changed. The map coverage is in direct proportion to the area covered, and is accurate when the scope is off-centered.

Since the map is produced on the face of the tube along with the radar information, there is no parallax error. Thus, with a single map and mapping unit, a number of ranges with corresponding plotting information are available for display on several indicators operating independently of each other. Figure 12-10 is an example of a video map.

The video map is subject to some drift, but slight errors resulting from drift can usually be corrected by a radar technician. Another disadvantage of the video map is the possibility of failure of the mapping unit which would result in no map on the PPI.

NOTE: Refer to ATC Handbook 7110.65 for procedures to be followed when radar mapping is not available.

Secondary Radar

Secondary surveillance radar is a separate system and is capable of independent operation; however, in normal air traffic control use, it is slaved with other radar. A display of both the primary and secondary radar targets is presented on the ASR indicator. The term RADAR BEACON is commonly used in reference to

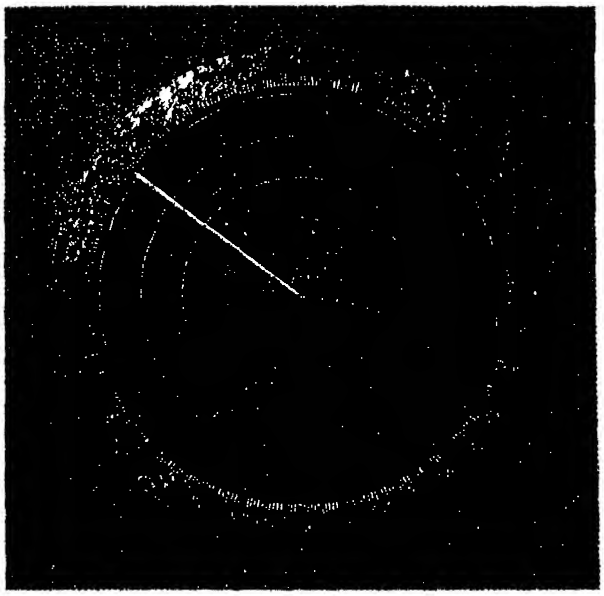

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Figure 12-10.—Video map.

secondary surveillance radar. Radar beacon systems are discussed later in this chapter.

IFF (Identification, friend or foe) equipment is a modification of surveillance radars. IFF Equipment provides controllers with a method of rapidly identifying aircraft. It consists basically of a transmitter, antenna, and receiver. The information obtained is displayed on the search indicator.

This basic equipment, known as the Mark X system, is capable of operating in three different modes of which Mode 3 is for air traffic control purposes. A Mode 3 signal is transmitted and a reply is received from every aircraft operating on Mode 3. A further modification was installed in the Mark X system, called SIF (selective identification feature). SIF gave a great deal of security to IFF by giving the operator many codes for each mode.

RADAR PERFORMANCE CHARACTERISTICS

When a radar system is developed that detects only flying aircraft and nothing else, the radar controller will have a nearly perfect system for controlling traffic. Such a system has not been developed yet, but with the MTI system you have the next best thing. Nevertheless, radar systems do have limitations and some of these are discussed in the following paragraphs.

Target Fades

An inherent feature of all radar systems with which the controller should become thoroughly familiar is target fading. Target fades varies with the type of equipment, antenna height, tilt angle of the antenna, atmospheric conditions, and the surrounding terrain. Target fades are apparent when an aircraft is over the antenna site. The degree and length of such a fade is determined by the amount of antenna tilt. It should be noted that the lower the tilt angle of the antenna, the better the low angle coverage. On the other hand, the higher the tilt angle of the antenna, the better the high angle coverage. Most antennas are set to give maximum coverage for the particular type of control being employed.

The coverage in range, altitude, and azimuth for a particular site is determined by means of a flight check evaluation, which is conducted by the FAA flight check team before the facility is commissioned. In the event that a previously unknown fade area is suspected, another flight check should be requested in order to verify or confirm its existence. The data obtained from the flight check gives the controller an indication of coverage and target fades inherent in the type of equipment being used. In order to understand the capabilities and limitations of the system, you should become thoroughly familiar with the coverage pattern and fade areas which were determined by the flight check.

NOTE: For further information and detailed procedures used in the conduct of these flight checks, refer to the United States Standard Flight Inspection Manual, NAVAIR 16-1-520, and NAVAIRINST 3721.1 (Series).

Anomalous Propagation

The atmosphere surrounding the earth is not uniform in density or moisture content; therefore, it is possible for local conditions to exist in which radar beams are bent upon passage through the atmosphere. Conditions under which the radar beam does not travel a straight line are called conditions of anomalous propagation. This condition is most apt to occur on days when there is little wind and when air temperature is different from the ground temperature.

Anomalous propagation is most prevalent over water where water evaporation causes a temperature and moisture gradient to exist. The refraction of dry or dense air is greater than that of moist or less dense air; therefore radar beams are bent in the direction of the dry or dense layers. Figure 12-11 depicts two conditions of anomalous

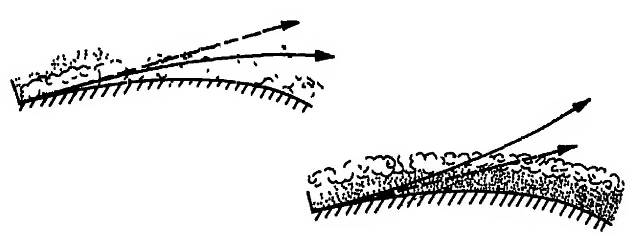

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Figure 12-11.—Anomalous propagation effect.

propagation with the atmosphere causing a downward and upward bending of radar beams.

Under conditions depicted in figure 12-11, targets hundreds of miles away may be detected even though they are far below the horizon. On the other hand, relatively close targets may not be detected.

False Targets

The proficient radar controller must be quick to recognize a temperature inversion as a false target. Such indications are often secondary reflections of radar energy from isolated refracting areas in a temperature inversion level. Correlation of radar reports with the National Weather Service records indicates that a temperature inversion is usually present when unidentified flying objects appear on the scope. These inversions often travel across the radar at tremendous speeds and in changing directions. Apparently this phenomenon is produced by isolated refracting areas travelling with the wind at or near temperature inversion levels. Although the exact size, shape, and composition of these isolated areas are not known, it is believed that they may be atmospheric eddies produced by a shearing action of dissimilar air strata. It appears that such eddies may reflect and focus the radar energy with a lens effect to produce a small concentration of ground return with sufficient strength to show up on the radar display.

Radar Jamming

Jamming, as used in conjunction with radar, is defined as an introduction of false radiation into radar and radar devices. False targets produced by jamming may appear on the scope at varying ranges and bearings or in some cases may clutter large portions of the scope.

Jamming may be classified into two main categories—active and passive. Active jammers are those which generate radar energy producing interference. Passive jammers are those which act as parasitic radiators such as chaff. Chaff is thin strips of aluminum or other metal cut to a particular length. When released from aircraft at high altitudes, the strips float down to the ground slowly and the resultant echoes cause large areas of clutter.

The Air Force has equipped the ejection seats of some of their training aircraft with chaff dispensing bags. In the event of crew ejection, chaff will disperse over a wide area and will remain visible in the form of clutter on radar scopes for a period of 30 minutes or so depending on the altitude of ejection.

Controlled jamming is conducted by the military and regulated by the FAA to preclude interference with air traffic control radar. Controllers observing jamming operations, when no prior notification has been received, should notify appropriate authority. Figure 12-12 is an example of chaff interference.

Electronic Radar Interference

Interference from other radar installations operating on a similar frequency may be encountered when two or more radar installations are in close proximity. Such interference appears

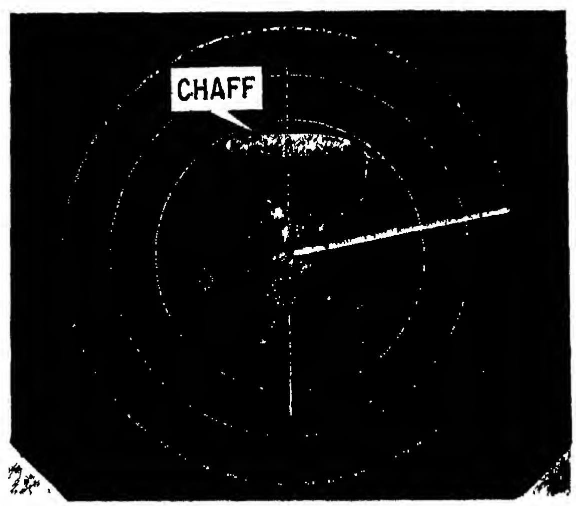

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Figure 12-12.—Chaff interference.

as shown in figure 12-13. When this interference is encountered, nearby radar installations should be advised to check the frequency calibration of their equipment.

Also, most radar installations have dual channels so that a standby channel is always available. At times, the standby channel transmits a signal that produces interference as shown in figure 12-14. In most cases, retuning by the technician decreases the amount of interference.

SURVEILLANCE APPLICATION

Surveillance radar is a potent tool for all air traffic control use. It releases the controller from the restriction imposed by the uncertainty which formerly existed as to the actual position of the aircraft. Accuracies of the radar indications are superior to human vision, and a clear plan position of all aircraft and their approximate headings within the range of the radar is indicated. The many advantages of such a display are obvious.

It is evident that if you can continually see the position of the aircraft you are controlling, you can relay information which will enable the pilot to make the necessary corrections in heading to bring him to his destination.

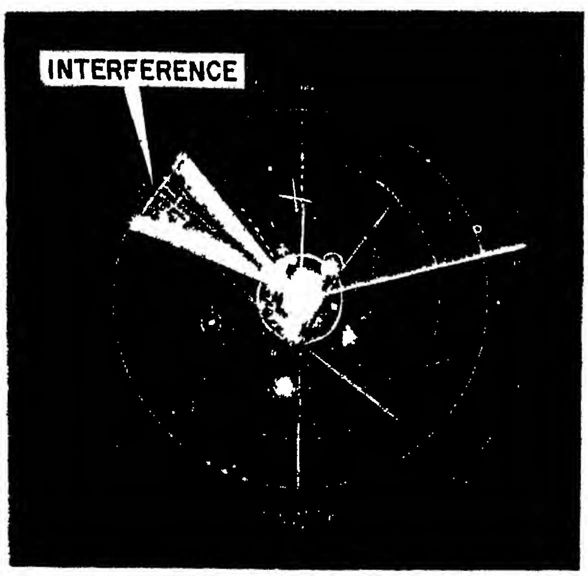

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Figure 12-13.—Interference from another radar set.

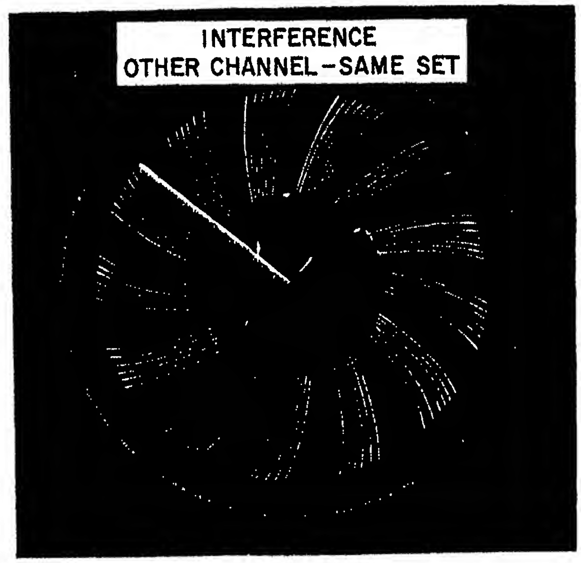

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Figure 12-14.—Interference from the standby channel.

In the case of terminal radar operations, lines are drawn to show runway extensions, and usually are marked to indicate distances from the runway. Using any suitable radiotelephone, you can then give the pilot heading instructions which will keep his radar target accurately on the approach lines, and inform the pilot of the exact distance from the runway at any time. Knowing the sea level altitude of the airport, and the fact that a normal rate of descent for the desired glide angle is 300 feet per mile, a controller can advise a pilot what his altitude should be each mile. Such an approach is perfectly practicable under ceiling conditions of 300 feet or higher.

EXERCISE

12-7. Explain the effect of clutter gating on the video presentation of a radar set.

12-8. State the effect of STC on the video presentation of a radar set.

12-9. What effect does circular polarization have on the video presentation of a radar set?

12-10. Special ATC Equipment which produces airways, fixes, airports, and extended runway centerlines electronically, at all ranges, on the face of a radarscope is the ______.

12-11. Special ATC Equipment which aids controllers in identifying selected aircraft from among other aircraft is ______.

12-12. In addition to MTI blind speeds, name five (5) other undesirable radar performance characteristics.

AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS)

Learning Objective: **Recognize the capabilities, limitations, and associated equipment of the ATCRBS.**

Functions of the air traffic control radar beacon are as follows:

1. Reinforcement of radar target.

2. Rapid target identification.

3. Extension of radar coverage area (up to 200 miles).

4. Transmission of altitude and other data.

NOTE: The altitude reporting portion of the ATCRBS will be discussed later in this chapter.

As we said earlier, secondary surveillance radar is the international term for the air traffic control radar beacon system. This term refers to the form of secondary radar used only in air traffic control, and is not applicable to any other type of secondary radar. Secondary surveillance radar is a separate system, and is capable of independent operation; however, in normal air traffic control use it is slaved with surveillance radar. A display of both the primary and secondary radar targets is presented on the associated plan position indicator.

The term radar beacon as used in this training manual refers to a secondary surveillance radar system having as component parts a functioning interrogator on the ground, a functioning transponder in an aircraft, and a display on an air traffic control radarscope. When the word radar is used, it refers to a primary radar system. Primary radar differs from secondary surveillance radar in that it displays reflected signals rather than signals which have been transmitted by an airborne transponder.

Secondary surveillance radar effectively counteracts the following shortcomings of primary radar:

1. Aircraft reflection areas vary with size and configuration, thus limiting radar effectiveness.

2. The radar display may be degraded by weather conditions, especially precipitation.

3. Ground clutter frequently impairs the radar display, even though the radar is equipped with MTI.

4. Radar is more vulnerable to blind spots in the antenna coverage pattern.

Aircraft targets, unaided by airborne transponders, are not filtered but are displayed to controllers for all aircraft within the radarscope coverage. This includes those that are above, below, or beyond a particular area of control jurisdiction. Such targets clutter air traffic control displays and make the job of identifying one aircraft from another more difficult. Thus, the performance of essential air traffic control functions may be more complex and time consuming.

BASIC RADAR BEACON SYSTEM

The ground equipment of the system is made up of three major components—the I/R unit, the antenna, and the decoder. Included in the I/R unit are the interrogator (transmitter), the receiver, and the pulse pair generator. The major function of the interrogator is to generate distinctive radio-frequency transmission in accordance with the mode in use. The action of the interrogator is similar to that of a primary radar transmitter as both transmit extremely short, powerful bursts, or pulses, of radio energy. In both systems the interval between transmissions is dependent upon the associated pulse repetition frequency (PRF); however, there is an essential difference in the transmission characteristics of the two systems. Radar transmits individual pulses while radar beacon interrogations consist of pulse pairs which are spaced in accordance with the interrogation mode. When a beacon system is used in conjunction with a primary radar, the interval between pulse pairs is related to the pulse repetition frequency of the primary radar equipment.

Simultaneous presentation of beacon and radar information requires that both system displays be correlated in range and azimuth. Range correlation is achieved by transmitting the beacon pulse pair a preset time before the radar pulse, in order to allow for the processing time in the transponder and in the decoder. A corresponding beacon pulse pair is not necessarily transmitted for every radar pulse. Azimuth correlation is accomplished by mounting both the beacon antenna and the primary radar antenna on a common pedestal. Consequently both antennas scan the same area simultaneously.

The receiver section of the I/R unit receives the replies from the transponder and passes them to the decoder.

The decoder accepts beacon video and beacon trigger signals from the I/R unit. The beacon video signals are processed in the decoder, and then passed to the radar PPI. Beacon video may go either to the radar video mixer or directly to the console, depending upon the primary radar equipment being used. In either case the beacon targets are displayed on the PPI with the primary radar targets. The decoder performs several functions depending on the control setting.

The transponder is the airborne unit of the system. The basic parts of a transponder are a receiver, a signal processing unit, and a transmitter. A transponder is an active device; however, it may be inactive at times. Before the transmitter portion will replay to an interrogation, specially keyed pulses must have been received and processed. When actuated, or triggered, the transmitter emits a series of specific reply pulses which are independent of and stronger than echoed radar signals. (See figure 12-15.)

The response differs from an echo in several other respects:

1. The strength of the response is independent of the intensity of the interrogating signal received.

2. Interrogation and reply frequencies are not the same.

3. The response signal is different from the interrogation signal.

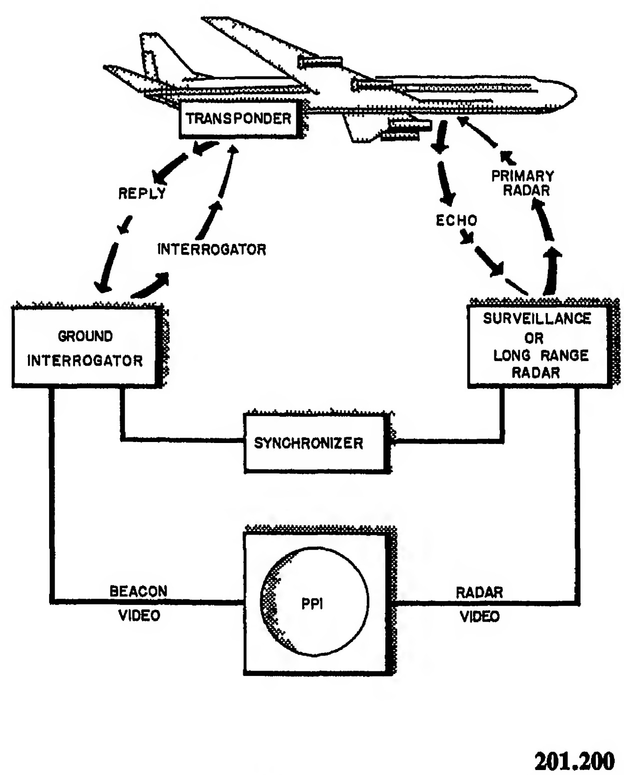

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Figure 12-15.—Primary and secondary surveillance radar systems.

4. A small delay is inherent between the receipt of an interrogation and the transmission of a reply. For standardization, this delay is adjusted 3 microseconds in duration.

Both primary and secondary radars are subject to variances, both internal and external, that may adversely affect the operational efficiency of the equipment. You must know when to expect such things as fades, false targets, and interference. And you must be able to cope with these situations when they occur on either the radar or the radar beacon equipment.

Secondary surveillance radar and primary radar both operate with signals received within the line of sight. A target must be within the radiated antenna pattern and be within scope range in order to be displayed on a PPI.

Aircraft attitudes affect the quality of the display, since the transponder antenna is normally located on the under side of the aircraft. If the aircraft is in a turn, the wings or fuselage may block the pulse pairs transmitted by the interrogator, and the transponder may not be activated.

Buildings or other obstructing surfaces, usually within 2 miles of the beacon antenna site, sometimes reflect either the interrogation or the reply. Reflections cause a false target to be displayed at a different azimuth from that of the true targets. These reflected targets are sometimes different in appearance from true targets and may be pivoted from the normal display position.

Both primary and secondary radars display slant range. Slant range is the most direct line between the ground antenna and the aircraft. Thus the position of the aircraft, as displayed on a PPI, is only an approximate geographical position.

ATCRBS APPLICATION

The standard secondary surveillance radar designed for use by FAA air traffic control facilities is the Air Traffic Control Radar Beacon Systems (ATCRBS) with 10 channel decoders. This equipment has been designed specifically for use in air traffic control and is versatile enough to handle present needs of both the domestic and international beacon program, as well an anticipated future expansion.

The ATCRBS is capable of making interrogations in any four of the six different modes shown in figure 12-16. Mode A has been designated as the civil/military air traffic control mode. Since civil mode A is the same as mode 3 in military equipment, this common air traffic control mode is called mode 3/A. Modes 1 and 2 are military tactical modes; mode B has been designated a civil air traffic control mode but is not used in the United States; mode C is used for automatic altitude transmissions. Mode D has been established but its use has not been specified.

DIRECT ALTITUDE AND IDENTITY READOUT (DAIR) SYSTEM

The Direct Altitude and Identity Readout (DAIR) System evolved through an exhaustive research program that was conducted jointly by the DOD and the FAA. This program is identified as AIMS, which is an acronym for ATCRBS IFF Mark XII Identification Systems.

The two primary objectives of the AIMS program were to improve air traffic control through the use of ATCRBS and to provide a secure military identification system. Other significant objectives of the program were to standardize equipment used by the services, coordinate implementation plans, and to make maximum use of existing facilities and resources of the services.

In order to achieve these objectives, the ATCRBS was expanded to 4,096 codes to allow

MODE	APPLICATION
1	MILITARY IFF*
2	MILITARY IFF*
3/A	COMMON (ATC)
B	CIVIL (ATC)
C	CIVIL (ALTITUDE)
D	CIVIL (UNASSIGNED)

*(Identification friend or foe)

201.201

Figure 12-16.—Interrogation modes.

the capability of automatically reporting altitude information directly to the controller's equipment. In addition to receiving altitude information from transponder equipped aircraft, the DAIR equipment presents easily readable, digitally derived synthetic display markers and numerical data blocks which do not fade from the scope as do primary radar targets.

Equipment Description

The interrogator equipment associated with the DAIR system is designated the AN/TPX-42. Figure 12-17 illustrates a simplified block diagram of the system.

A review of the fundamentals of radar operation discussed earlier in this chapter will assist you in obtaining a better understanding of the operating principles of this equipment. For a more detailed description of the individual components, refer to the appropriate technical manual at your facility.

It should be noted that the AN/TPX-42 equipment can be used with existing PPI consoles, either in a radar air traffic control facility room or in conjunction with a mobile GCA unit. Future expansion of the system will include specially designed operator consoles.

There are several types of display markers generated by the AN/TPX-42 equipment; figure 12-18 shows these markers and provides a legend of their meaning.

The data block displayed adjacent to the centermark (aircraft's actual position) consists of the assigned beacon code that the aircraft is squawking and the altitude being flown; this altitude is indicated in 100-foot increments (MSL).

Altitude data is received through Mode C interrogations to aircraft transponders and can

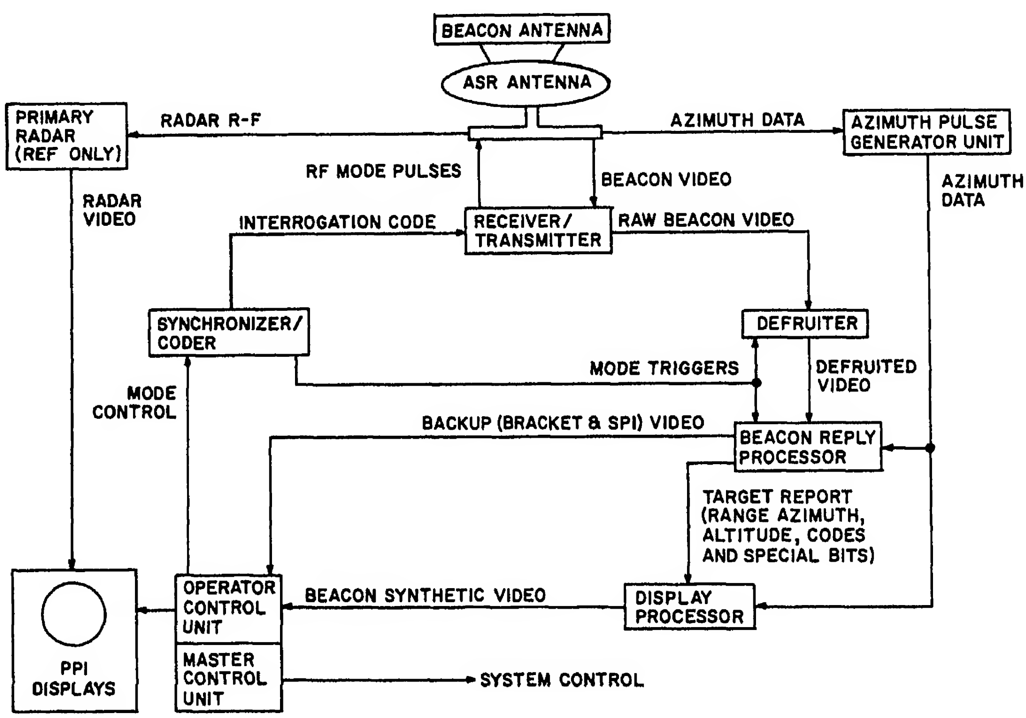

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Figure 12-17.—AN/TPX-42 block diagram.

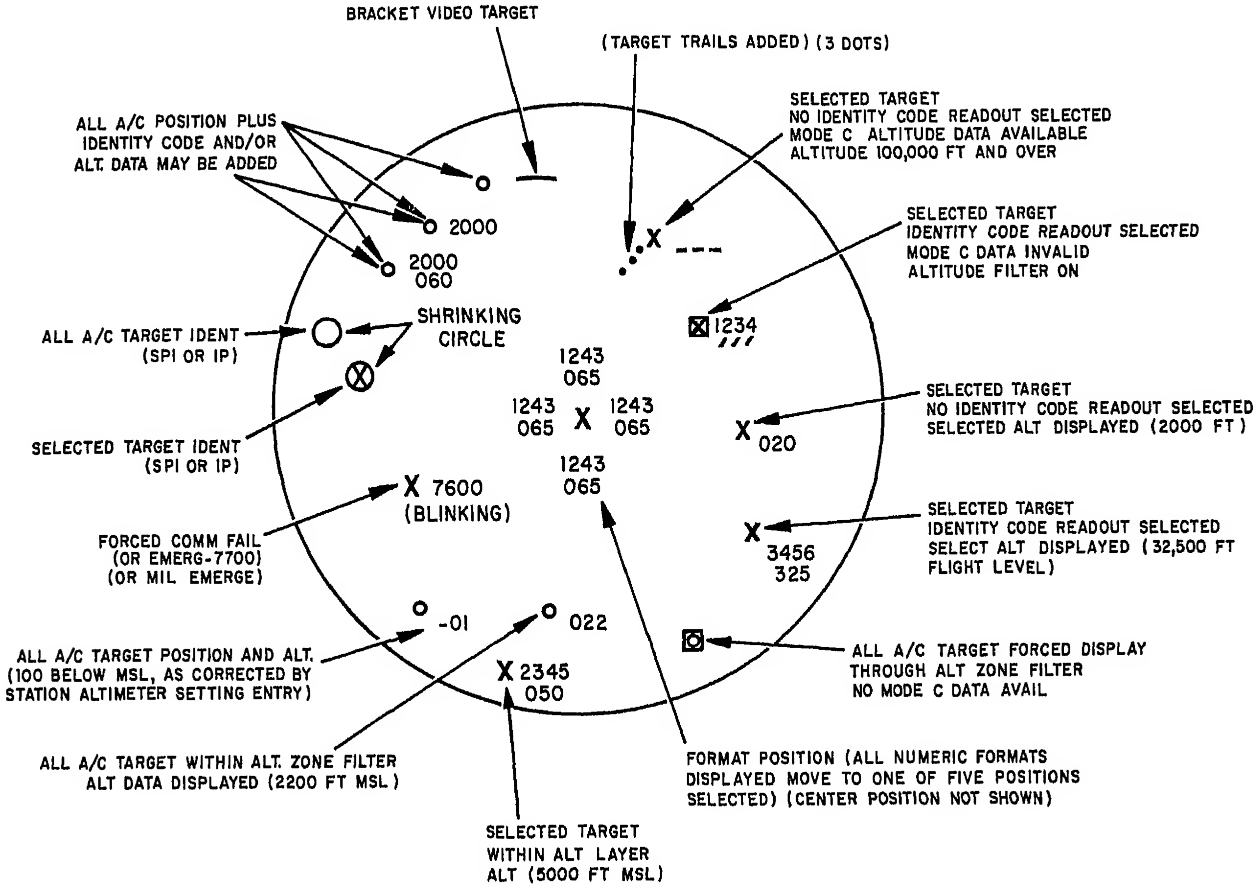

Figure 12-18.—DAIR display.

be filtered to display only aircraft targets within controller-selected altitude levels.

With the presentation of synthetic markers and numeric tags for beacon information, you also have the capability of displaying primary radar targets on the scope. In addition, the system possesses a backup feature which allows for the presentation of beacon bracket decode video to be superimposed on the primary radar targets.

Operating Procedures

Individual controllers may select any of the presentations available with the system (as noted in figure 12-18) by use of a control panel shown in figure 12-19.

This control indicator is designed to be located at or adjacent to each PPI console. This indicator provides you with a selection of interrogation modes as well as the visual system status indication and with audible as well as visual notification of aircraft emergencies and communication failures (discussed later in this section).

You also control the display of symbology and numerics from this unit.

Figure 12-20 illustrates the master control unit that is located at the supervisor's console. This unit need not be situated at a radar console but is designed to be located within the radar control room or GCA unit as appropriate.

Detailed operating procedures for both the remote control indicator and the master control unit will not be outlined here; ACs assigned to

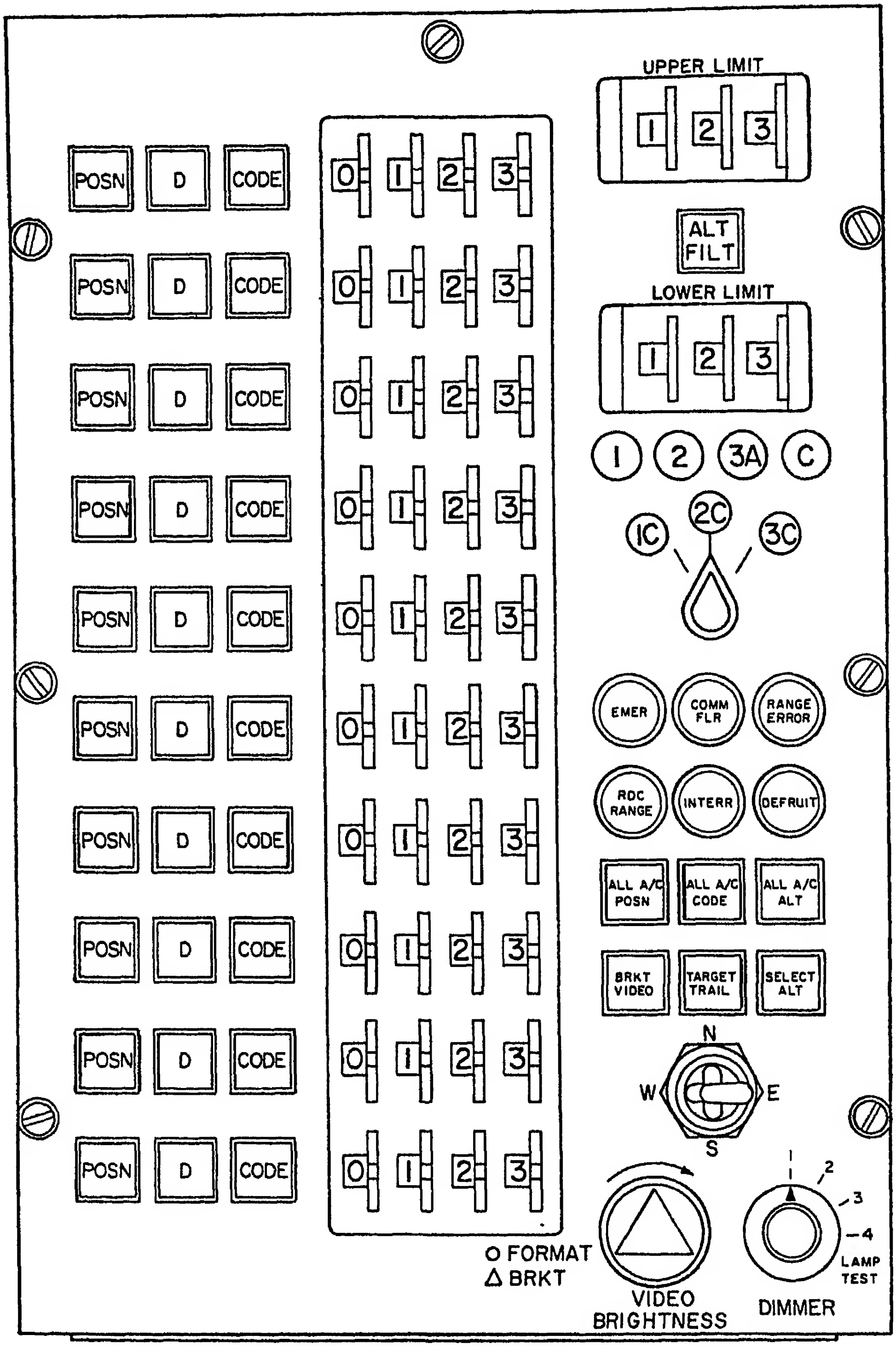

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Figure 12-19.—Indicator control front panel.

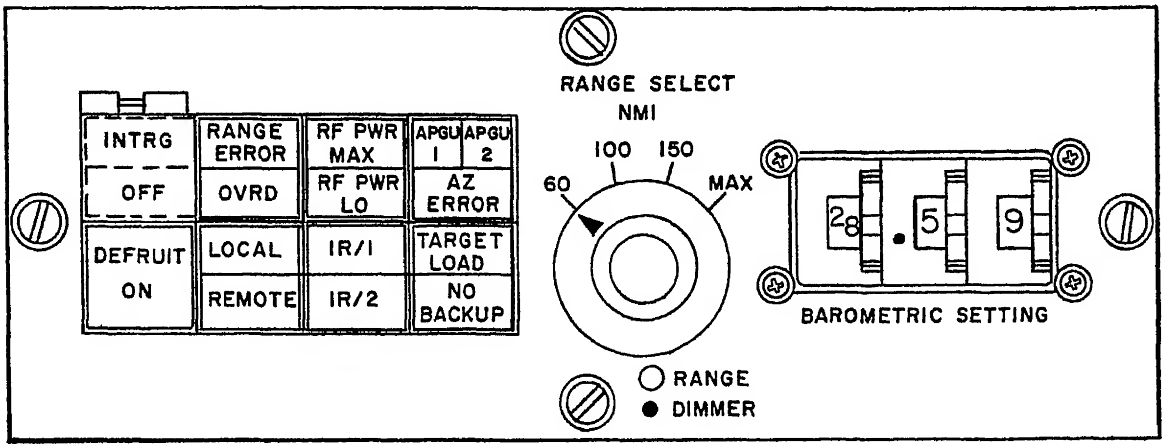

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Figure 12-20.—C-8626/T master control unit.

radar facilities which possess the DAIR system will receive detailed instructions in the operation of the equipment.

Several noteworthy features of the AN/TPX-42 system do, however, deserve mention at this time.

When you desire coverage within a particular altitude sector, you may set the desired upper and lower limits on the control indicator (see example in figure 12-19) and only replies from aircraft flying within these limits will be displayed; all others above or below the desired limits will be filtered out with the exception of aircraft not transmitting altitude information and aircraft experiencing an emergency or communications failure.

When pilots indicate by the appropriate code that they are experiencing an emergency (code 7700) or loss of communications (code 7600), a red light located on the operator's control indicator (EMER in figure 12-19) is activated and flashes on and off. In addition to this visual alarm, an audible buzzer in the box will be heard in short bursts for approximately 5 seconds.

The select code position symbol X indicates the location of the aircraft on the controller's scope, and the emergency or communications failure code and altitude (if available) is presented adjacent to it.

To facilitate locating the target on the scope, the symbol and numerics blink on and off at a rapid rate.

Another excellent feature of the system allows for the tape recording and playback of processed targets. This capability can be invaluable in the area of accident investigation and also to enhance controller training.

EXERCISE

12-13. List four functions of the air traffic control radar beacon system.

12-14. State four (4) advantages secondary radar has over primary radar.

12-15. In the basic radar beacon system, the ______ is the ground unit and the ______ is the airborne unit.

12-16. What mode(s) are used for (1) common air traffic control, (2) altitude readout, and (3) military tactical?

12-17. What is the maximum number of codes available within the ATCRBS?

12-18. What is the designation of the equipment associated with the DAIR system?

12-19. What are the appropriate codes for an aircraft experiencing (1) an emergency, and (2) loss of communications?

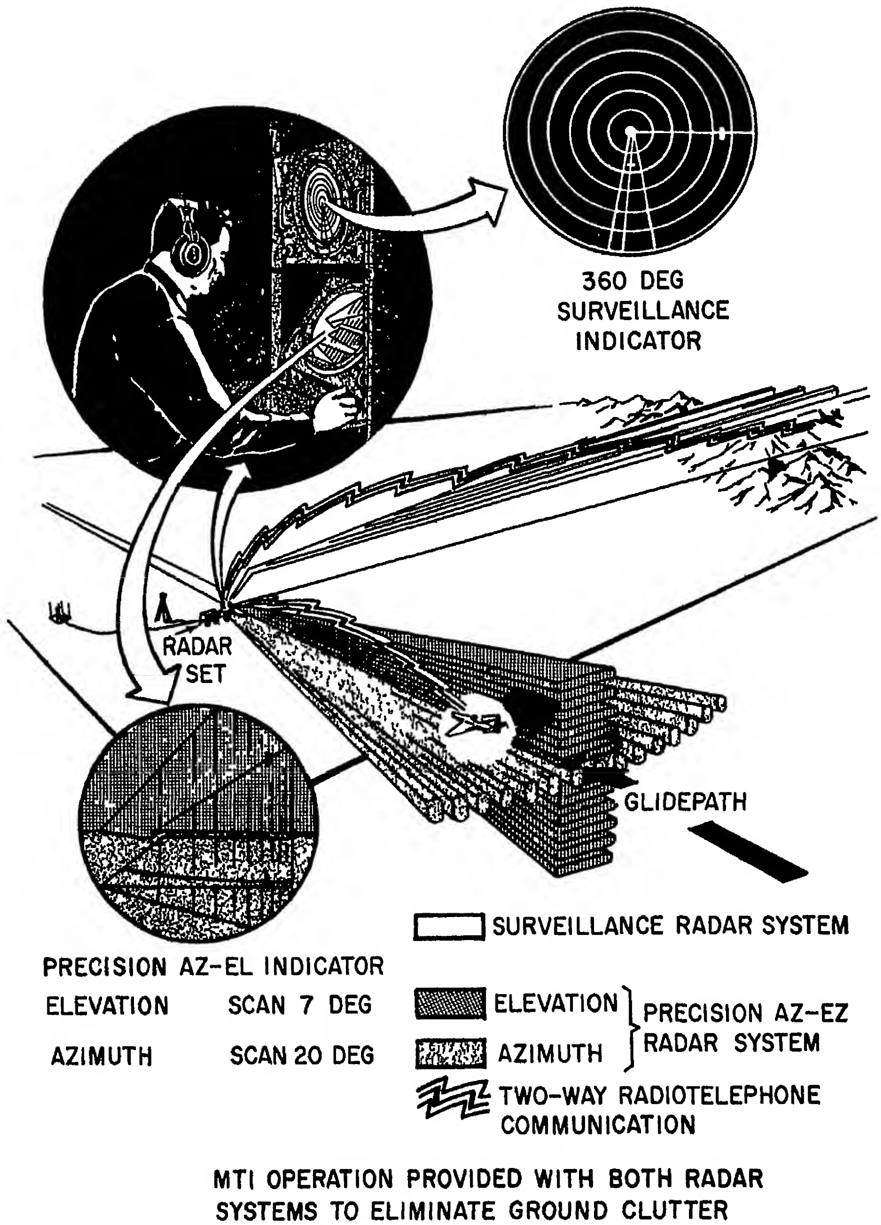

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Figure 12-21.—Functions of a GCA unit.

TYPES OF ATC EQUIPMENT

Learning objective: **Identify the types, uses, and operating characteristics of ATC radar systems.**

Ever since naval aircraft operations began, the Navy has actively sought to develop reliability in all-weather landing systems both ashore and afloat. Research and development of such systems is a continuous process taking advantage of new equipment and ideas as they are introduced. Now, because of precision radar, high-speed data processing, and microcircuit electronics, new equipment is being introduced at a fairly fast pace.

In this section, an attempt is made to briefly describe radar equipment in general use. It is not intended to be all-inclusive or a substitute for familiarity with the equipment in use at your facility; neither is it a substitute for study of the operator's section of the applicable technical manual.

GROUND CONTROLLED APPROACH (GCA)

Ground controlled approach (GCA) is a radar system providing air navigation to an aircraft. Through the use of air surveillance radar, precision approach radar, and radio communications, a ground operator assists a pilot on approach during weather conditions of low visibility and ceilings. Unless radar beacon is being used, no special airborne electronic components are required. Thus, a two-way functioning radio is all that is necessary in the aircraft.

The GCA unit consists of a surveillance radar system and a precision approach radar system (PAR) for controlling the initial and final approach portion of an approach. The surveillance radar is displayed on a PPI scope. The PAR is displayed on an AZ-EL scope providing the controller with a precision radar picture of azimuth and elevation coverage in the final approach area. (See figure 12-21.)

Figure 12-22 shows the AN/CPN-4 GCA unit. The CPN-4 is a self-contained, mobile radar unit

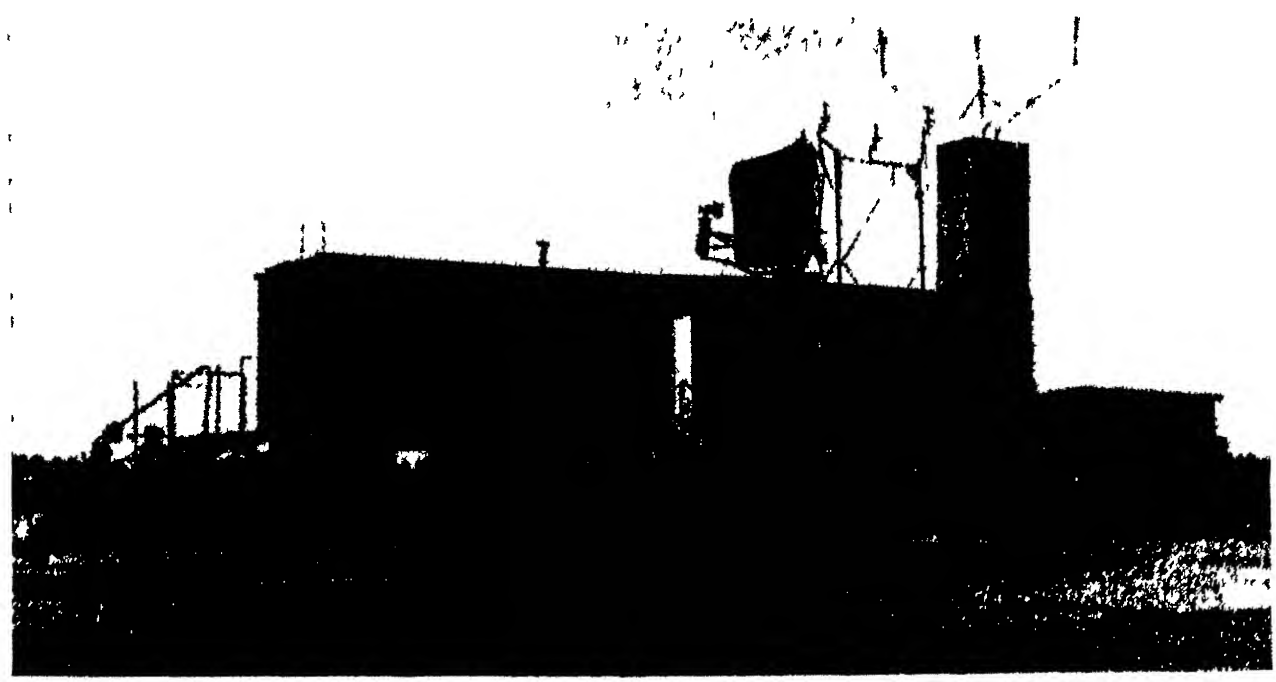

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Figure 12-22.—AN/CPN-4 GCA unit.

designed for controlling and landing aircraft during periods of reduced ceiling and visibility.

The CPN-4 shown in figure 12-22 is on an electrically operated turntable that facilitates the positioning of the GCA equipment to the desired runway. With this turntable, the time required to reposition the GCA unit to the duty runway is considerably reduced. This type facility normally has its radar remoted to a central control room in the operations building.

AN/FPN-47 (ASR-5) RADAR

The AN/FPN-47 is one of the surveillance radar systems in use as part of the air traffic control system.

The AN/FPN-47 has all four of the special features common to air traffic control radars. These are Moving Target Indicator (MTI), Sensitivity Time Control (STC), Fast Time Constant (FTC), and Circular Polarization (CP).

This system has a maximum radar video range of 60 miles and a maximum radar beacon range of 200 miles. The radar beacon video can be displayed in conjunction with the normal and MTI video on all sweep ranges except the 200-mile range. With the 200-mile range selected, radar and radar beacon video are displayed simultaneously for the first 60 miles of the sweep, and radar beacon video only is displayed from 60 to 200 miles. Six fixed ranges of 6, 10, 20, 40, 60, or 200 miles may be selected by the operator, and two variable sweep ranges are available for selection from 6 to 60 miles. The 6- and 10-mile ranges

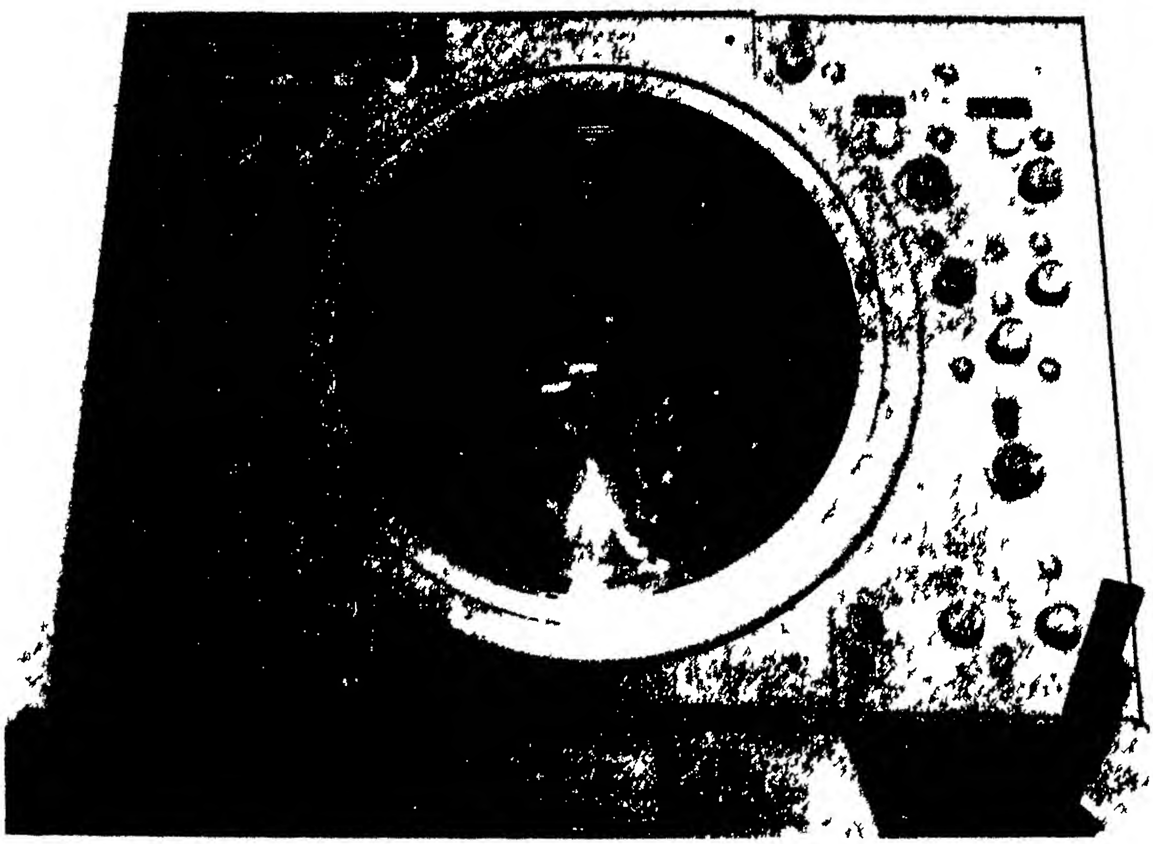

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Figure 12-23.—Airport Surveillance Radar Display System (ASRDS-2).

provide range marks at 2-mile intervals; the 20-, 40-mile, and first variable range at 5-mile intervals; the 60-mile and second variable range at 25-mile intervals; and the 200-mile range at 25-mile intervals. The altitude range of the FPN-47 is from 0 to approximately 40,000 feet MSL.

An electronic cursor and range strobe are also provided with this equipment. The cursor origin may be selected as centered with the radar sweep or off-centered and manually positioned on any desired target and cursor azimuth aligned and range strobe positioned on any other target. Then the target range and bearing can be read from indicators on the front panel of the PPI console. This provides accurate range and bearing of targets from the antenna site (centered) or relative range and bearing between two targets (off-centered).

The surveillance display illustrated in figure 12-23 shows the PPI console used in the FPN-47 radar system. A newer, and much larger, radar indicator, OD-58, has been introduced to Navy ATCFs (figure 12-24). It provides the same

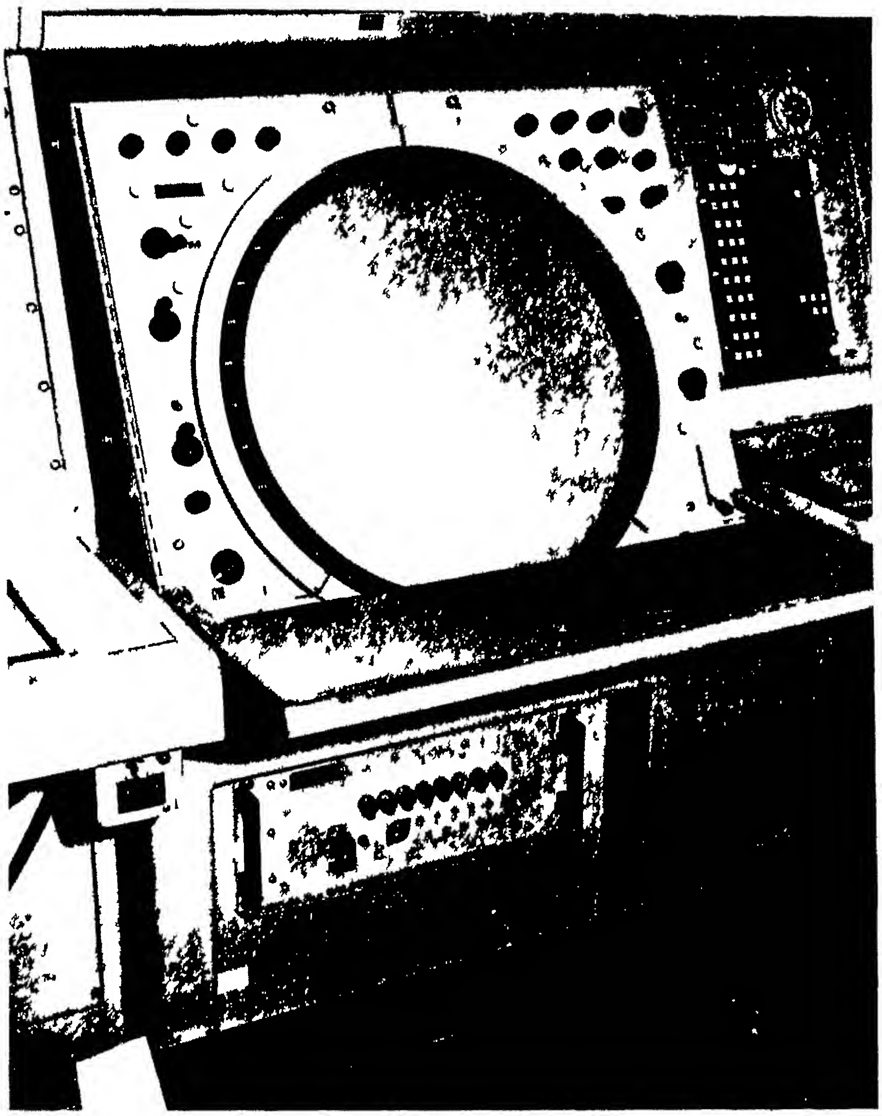

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Figure 12-24.—OD-58/T.

common controls found on most ATC radar scopes.

GPN-27 (ASR-8) RADAR

The newest, state-of-the-art radar being installed at Navy ATCFs is the ASR-8. The ASR-8 is a solid-state, airport surveillance radar system used to detect aircraft within 60 miles of the antenna site (see figure 12-25). The system is designed for maximum reliability and ease of servicing. Except for the antenna, major assemblies are duplicated to provide dual-channel operation.

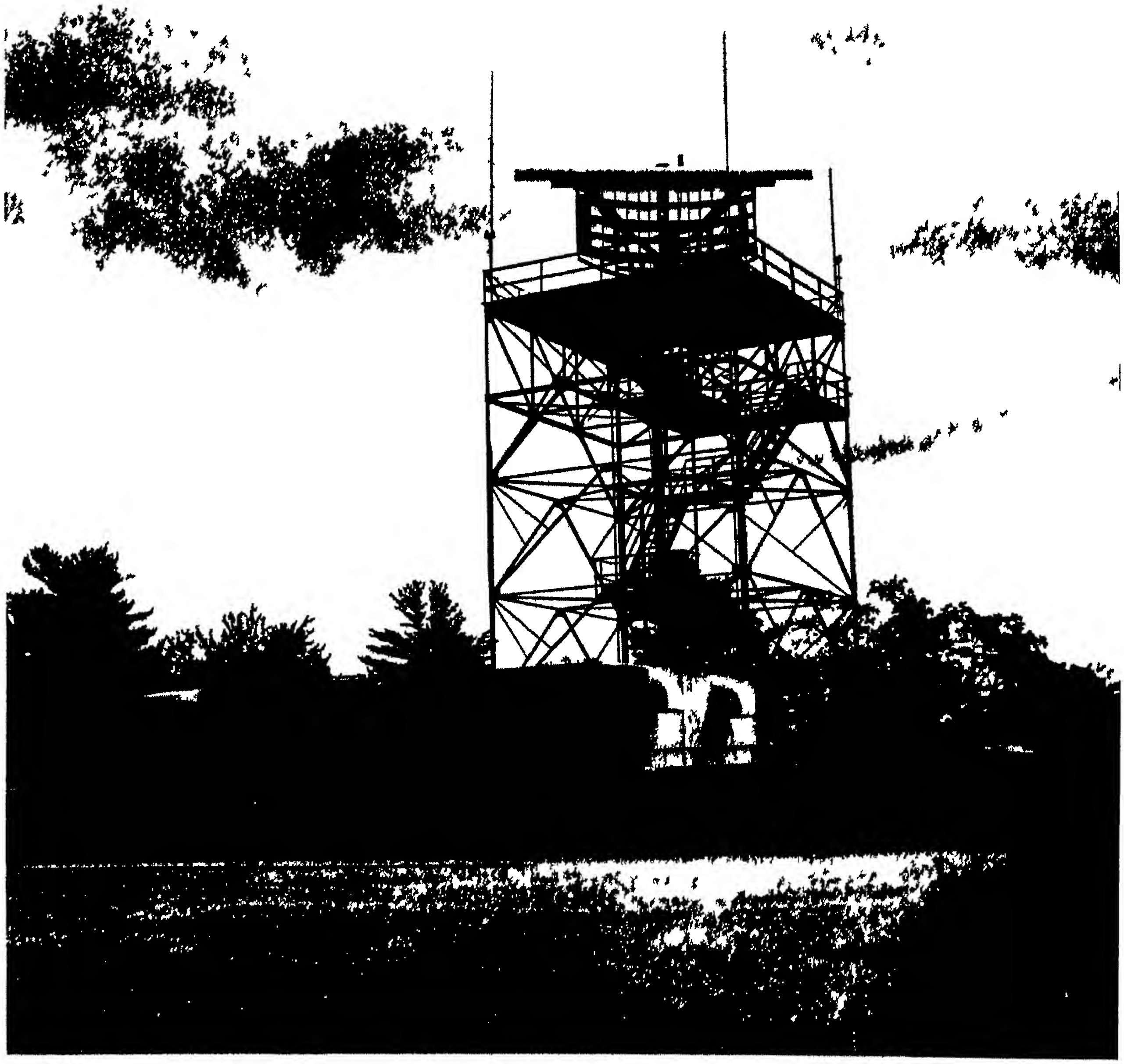

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Figure 12-25.—ASR-8 radar unit.

If one channel fails, the operator can switch to the standby channel.

The ASR-8 offers the same functions as the ASR-5 and is interfaced with the TPX-42A system. In addition, the ASR-8 uses a staggered PRF (discussed earlier in the chapter) to prevent the occurrence of blind speeds caused by MTI. For more detailed information on the capabilities and operating controls of the ASR-8, refer to the appropriate technical manuals.

FPN-52 RADAR

The function of the FPN-52 is the same as that shown in figure 12-21 for the precision portion of a GCA unit. In order to track both the course and the glidepath of aircraft on approach, the antenna system of this radar scans or "looks" in both the vertical and horizontal planes. The two scans (elevation and azimuth) are shown on the map face of an AZ-EL scope as shown in figure 12-21.

The coverage of the FPN-52 is 7 degrees in elevation and 20 degrees in azimuth in the final approach area with a range of at least 8 miles. Normal and MTI video range marks at 1-mile intervals, cursors (centerline and glidepath), and servo data information are displayed on the AZ-EL scope. A logarithmic time base sweep is used on the AZ-EL scope to give greater emphasis to more critical, close-in targets. Thus the glidepath cursor appears slightly curved on the scope although it represents a straight line in space. The first few range marks are comparatively far apart, and the more distant ones are comparatively close to each other. An aircraft will appear to pick up speed on its approach as its range decreases. An approaching aircraft may be tracked by means of the antenna servo. Antenna servo control is used to move the azimuth antenna up or down and/or the elevation antenna right or left. This allows the controller to center the radar beam on the aircraft even though it may be considerably off the desired course or glidepath.

The precision display illustrated in figure 12-26 shows the AZ-EL scope used with the FPN-52 radar system. For more details on the capabilities and operating controls used by operators, refer to the appropriate technical manual for this equipment.

FPN-63 RADAR

The FPN-63 PAR radar (figure 12-27) is now being installed at Navy ATCFs. It is a solid-state unit and is mounted on a remotely controlled turntable. The coverage of the FPN-63 is 8 degrees in elevation and 20 degrees in azimuth. It allows either a 10- or 20-mile range selection. When MTI is used, the RANGE SELECT switch will choose either 10 or 15 miles. The 5-mile range marks on the AZ-EL scope are brighter than the others.

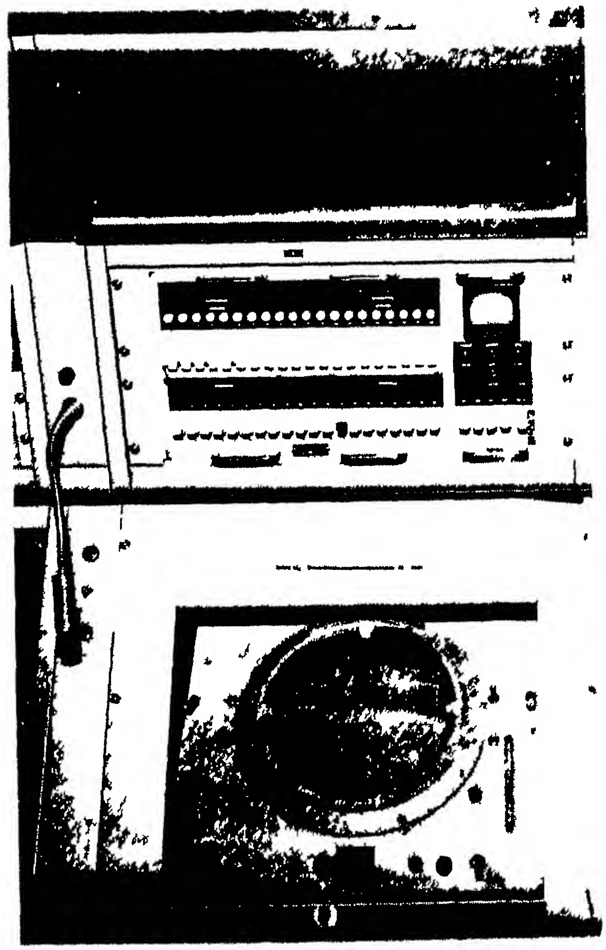

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Figure 12-26.—Precision radar display.

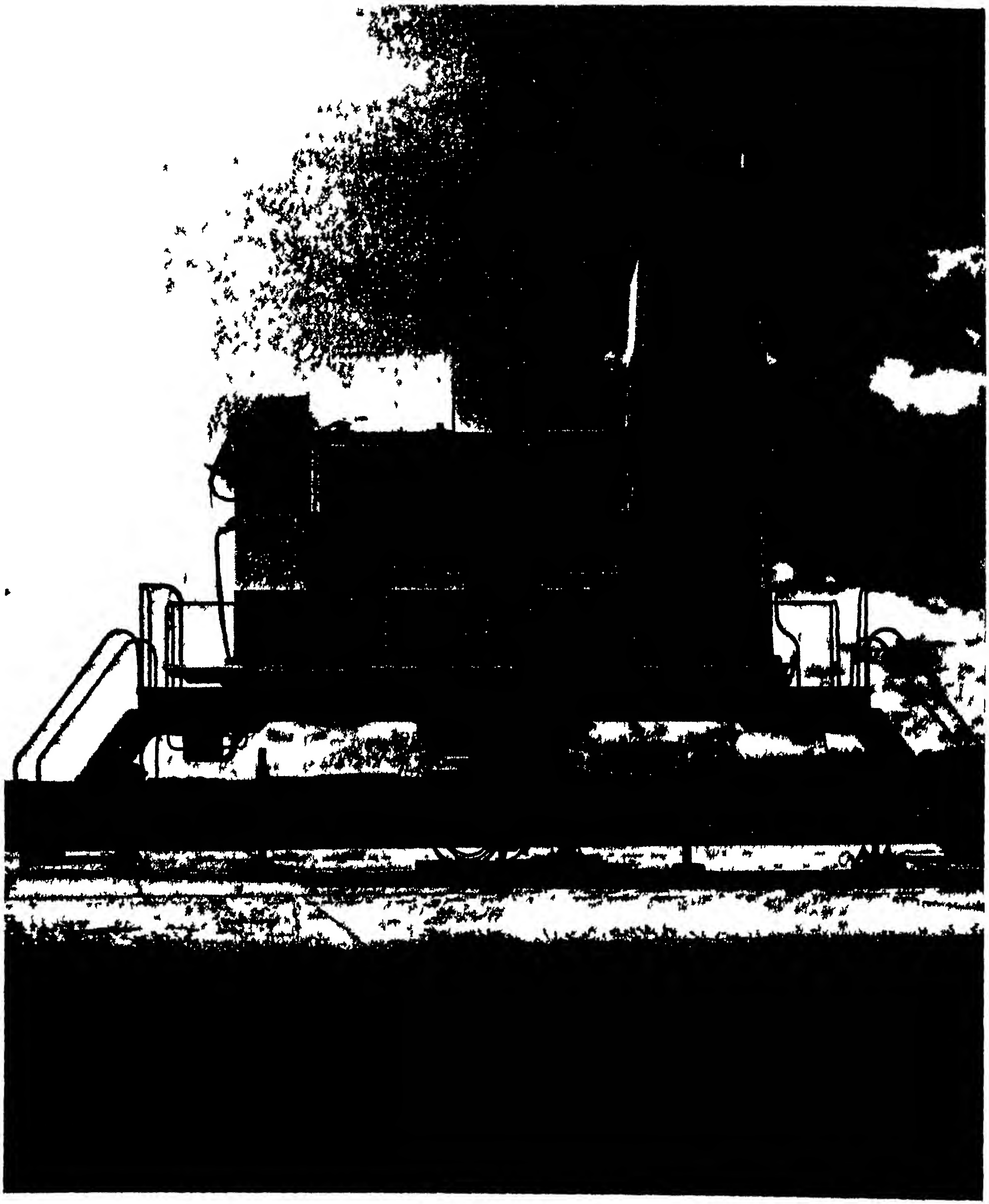

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Figure 12-27.—FPN-63 PAR radar.

There is also a PAR Minimums Marker on the elevation scan which marks the decision height (DH) for the runway in use.

In addition to staggered PFR, the FPN-63 has an MTI velocity offset control. In cases of bad weather or blocks of trees showing on the scope when MTI is selected, you may vary this control to cause these types of echoes to be cancelled.

ASR/PAR APPROACH TOLERANCES

The Navy, through OPNAVINST 3721.1, has set the tolerances which must be met when conducting radar approaches. These tolerances are discussed below.

Surveillance Approach (Straight-in)

The ASR approach course line must coincide as nearly as practicable with the runway centerline extended. Maximum error left or right of the runway edges must not exceed 500 feet at a point 1 mile from the approach end of the runway.

PAR Approach

The course deviation, in a PAR approach, must not exceed 30 feet or 0.2 degree, whichever is greater at the runway threshold. The range information given must be accurate within plus or minus 2 percent. In addition, the PAR radar must be capable of detecting an aircraft on the runway centerline extended, at an altitude of 2,000 feet and distance equal to the maximum range of the scope.

RADAR APPROACH CONTROL SIMULATOR (15G20)

The Radar Proficiency Simulator developed by Hydrosystems, Inc. is designed to provide refresher, upgrade, and proficiency training for Air Traffic Control (ATC) controllers. RAPS simulates a realistic ATC environment by generating, in real time, simulated aircraft targets which are displayed on radar indicators. The system is designed to generate up to 40 primary and secondary radar targets for Airport Surveillance Radar (ASR) and up to 8 primary radar targets for Precision Approach Radar (PAR).

RAPS is designed to provide up to seven (7) training positions. The seven (7) communications modules can be located at any combination of ASR and PAR radar indicators. The communication modules and pseudo pilot consoles are linked together by the RAPS communications system.

The simulator provides 15 programmable fixed targets (navigation fixes) and up to 40 moving targets.

RAPS simulated targets, which are indistinguishable from live targets, can be displayed simultaneously with live targets. The display of simulated targets is selectable at each indicator (trainee position); therefore, simulated targets will appear only on the desired indicator. When simulated data is selected, a lamp is lighted at the activated position, thus the trainee and instructor are alerted that both live and simulated targets will appear.

RAPS is designed to be responsive to many radar features. These include Sensitivity Time Control (STC), stagger PRF, MTI gain, MTI Interval (range), and Normal gain. The system is also responsive to wind parameters and provides for a programmable boundary level altitude.

In addition to primary targets, RAPS generates secondary (ATCRBS) radar targets to produce simulated bracket video coincident with simulated primary and to activate full ATCRBS symbology. Special circuits are employed to ensure simulated ATCRBS targets do not interfere with live ATCRBS targets. The pseudo pilot can select any one of 4096 ATCRBS identification codes including Emergency, Communications Failure, and Hi-Jack codes and also can "IDENT" when commanded by the ATC radar controller (trainee). The Mode C reply (altitude reporting) is reported automatically as a function of the altitude of the simulated aircraft or it can be switched off if desired.

The 15G20 can be interfaced with any of the above mentioned radars.

EXERCISE

Indicate whether each of the following statements is true (T) or false (F) by placing T or F in the blank spaces provided.

12-20. ________. GCA is accomplished by coordinating the use of air surveillance radar on the ground and the interrogator in the aircraft.

12-21. ________. The CPN-4 is a self-contained, mobile radar unit used to control the approach of an aircraft during periods of reduced ceiling and visibility.

12-22. ________. The FPN-47 has a maximum range of 60 miles.

12-23. ________. TPX-42 equipment may be interfaced with the FPN-47 and ASR-8 radars.

12-24. ________. The ASR-5 radar display uses an AZ-EL scope.

12-25. ________. The ASR and PAR radars discussed in this section all have MTI, STC, FTC, CP, and staggered PRF.

12-26. ________. The FPN-52 radar has a 7-degree elevation and 20-degree azimuth scan coverage of the final approach area and a tolerance of 500 feet left/right of the runway centerline at a point 1 mile from the approach end of the runway.

12-27. ________. The FPN-63 can provide for a 15-mile PAR approach.

12-28. ________. An aircraft on PAR final approach should be within 30 feet left or right of the runway centerline extended when over the runway threshold.

12-29. ________. The 15G20 simulator provides up to 15 simulated targets which can be displayed simultaneously with live radar/beacon targets.

CHAPTER 13

RADAR OPERATIONS

AIR TRAFFIC CONTROL FACILITY

With the establishment of ATC facilities at certain major air stations, the requirement to provide continuous service for IFR flight operations was recognized. To meet this requirement, radar facilities were constructed which encompass the control functions for all phases of flight under instrument flight rules for these terminal areas. Figure 13-1 shows a typical radar control room.

The central control room is located in the operations building and is accessible to the visual control tower. This room contains remote radar scopes and control consoles for each of the following radar equipments: Medium Range Air Traffic Control Radar; Short Range Air Traffic Control Radar; Precision Approach Radar; Direct Altitude and Identity Readout (DAIR) equipment; and certain other maintenance and operational controls. Additional equipments located in the control room are radar beacon code equipment, a video mapper, a selective communications and intercommunications system, wind direction and velocity indicators, as well as an altimeter setting indicator. At stations that use closed TV circuit for weather briefings, a TV set may also be installed.

The mission of a Navy Air Traffic Control Facility (ATCF) is to provide safe, orderly, and expeditious movement of air traffic within the facility's area of control, to and from operating areas, and into and from the national airspace system.

Services provided in accomplishing this mission include, but are not limited to the following: departure control; the capability to effectively transition departing aircraft into the en route flight structure; provide approach control service to arriving aircraft; conduct and monitor instrument approaches during periods of IFR weather conditions; and provide assistance to aircraft in emergency situations.

Specific duties and responsibilities of individual controllers will be detailed later in this chapter.

INTERRELATIONSHIP OF OPERATING POSITIONS

Learning objective: **Identify the duties and responsibilities of radar air traffic controllers.**

In order that all phases of air traffic control at a Navy ATC facility be adequately manned by competent controllers, a general knowledge of the duties of all operating positions is a must. This policy is strongly recommended in current OPNAV Instruction 3721.1 (Series). Cross training of personnel at an ATC facility creates an extremely flexible air traffic control division. Also when you, as a controller, transfer you will have undoubtedly gained valuable experience that should benefit not only yourself but your next duty station as well. OPNAV Instruction 3721.1 directs commanding officers to make suitable entries in the service record of a controller considered properly qualified to control instrument traffic.

Certification and Qualification

NOTE: Personnel performing controller functions, except for controllers in training, must be

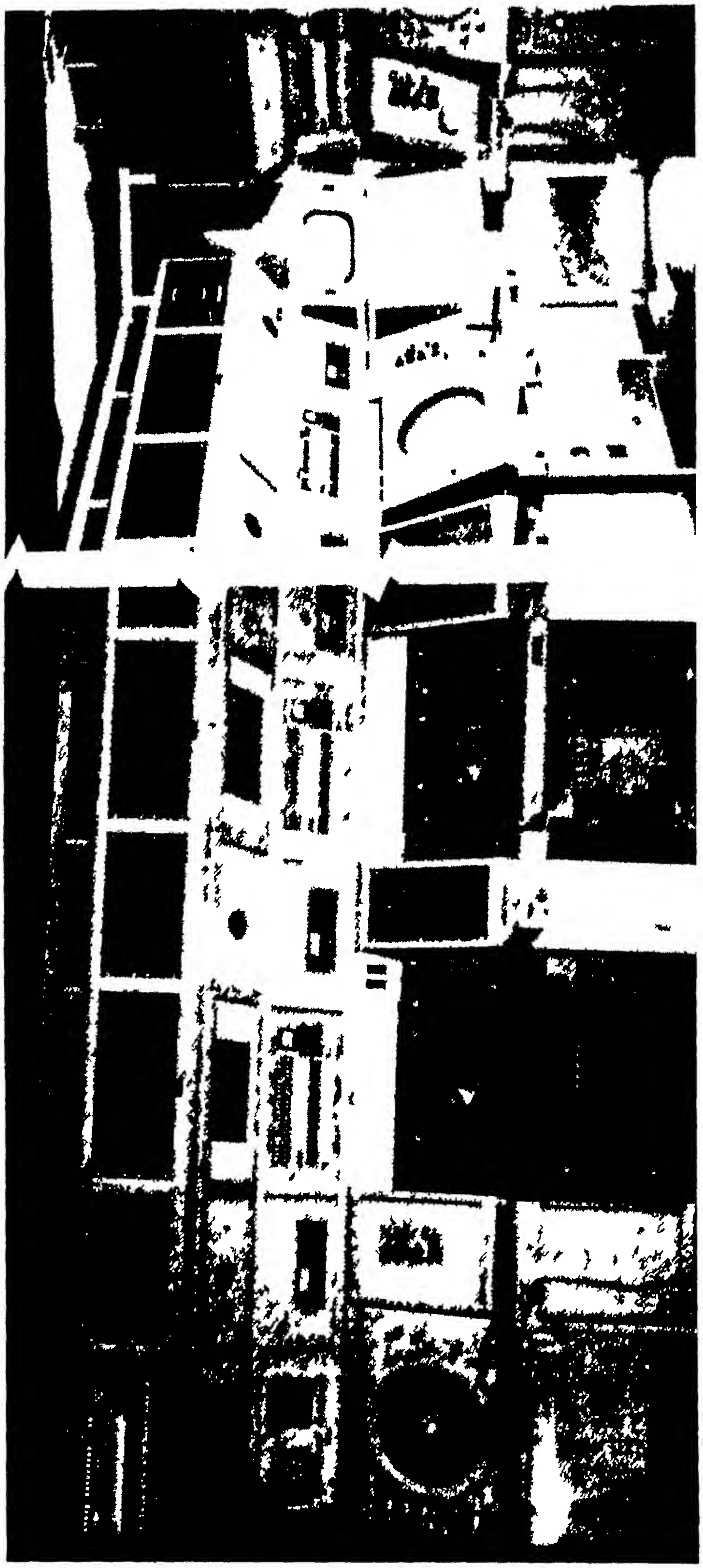

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Figure 13-1.—Radar control room.

facility rated and/or qualified for the assigned position of operation and function.

In addition, radar controllers (including radar approach control) must be graduates of the radar block of the Navy's Air Traffic Controller School or an equivalent course. Information concerning the qualifications required for the attainment of a Facility Rating can be found in chapter 2 of this manual.

Billet Description

The functions and responsibilities set forth in this section are applicable to Air Traffic Control Facilities (ATCFs) which provide radar air traffic control services, regardless of equipment installation or configuration. However, operating positions may be added, deleted, or combined as necessary to meet local requirements.

RADAR BRANCH MANAGER.—The radar branch manager possesses the appropriate ATCS certification for the type facility assigned and is designated by the ATCF officer. The function of the radar branch manager is to assist the ATCF officer in managing matters pertaining to radar operations. Duties, responsibilities, and authority include the following:

1. Maintaining a current library of facility directives and other pertinent regulations pertaining to radar operations.
2. Maintaining radar branch equipment including recording of outages and action taken to correct discrepancies.
3. Maintaining operational continuity between various watch teams.
4. Qualifying personnel on individual operating positions and recommending certification in conformance with this manual and local directives.
5. Ensuring the currency of controllers.
6. Evaluating and recommending to the facility officer operational readiness of branch equipment.
7. Supervising FAA/military flight checks.
8. Providing technical assistance to the ATCF Officer in development of procedures.

RADAR SUPERVISOR.—The radar supervisor is responsible to the Facility Watch Supervisor (FWS) for operational efficiency of the watch team. The radar supervisor shall be qualified on all radar operating positions and possess the appropriate ATCS rating(s) for the type facility assigned. Duties of the radar supervisor include the following:

1. Coordinating and directing control of air traffic within assigned airspace.
2. Briefing the radar watch team on weather conditions, traffic, equipment status, and field conditions.
3. Assigning personnel to operating positions according to individual qualifications and training requirements as directed.
4. Assigning trainees to qualified controllers for supervision.

Operating Positions

APPROACH CONTROLLER.—The Approach Controller is responsible for coordination and control of all instrument traffic within the ATC facility area of jurisdiction. Primary duties of the approach controller include the following:

1. Issuing ATC clearances and advisory information to aircraft under approach control jurisdiction.
2. Maintaining radar surveillance of assigned areas and providing radar services to aircraft as required.
3. Determining the separation and sequence to be used between aircraft.
4. Initiating/accepting radar handoffs from adjacent sectors/facilities.
5. Providing assistance and priority of services to aircraft in emergency situations.
6. Utilizing any or all other operating positions as necessary.

DEPARTURE CONTROLLER.—The Departure Controller is responsible for maintaining radar surveillance of the assigned area of jurisdiction and providing radar air traffic control services as required. Duties of the departure controller include the following:

1. Issuing clearances and advisory information to aircraft under departure control jurisdiction.

2. Initiating/accepting radar handoffs to adjacent sectors/facilities.

ARRIVAL CONTROLLER.—Duties of the arrival controller include the following:

1. Maintaining radar surveillance of the assigned area of jurisdiction and providing radar air traffic control services as required.
2. Issuing clearances and control instructions to aircraft operating under arrival control jurisdiction.
3. Accepting radar handoffs from approach control and providing radar air traffic control services to aircraft as required until the aircraft reaches approach minimums or is handed off to a final controller or adjacent facility.

FLIGHT DATA POSITION.—Duties of the controller operating the flight data position include the following:

1. Operating communications equipment associated with the flight data position.
2. Receiving and relaying aircraft movement data.
3. Preparing and posting flight progress strips.
4. Operating Flight Data Entry and Printout (FDEP) equipment.
5. Operating Automatic Terminal Information Service (ATIS) equipment.
6. Monitoring NAVAID alarm systems.

FINAL CONTROLLER.—Duties of the final controller include the following:

1. Providing instructions necessary for an aircraft to conduct an Airport Surveillance or Precision Approach Radar (ASR/PAR).
2. When required, monitoring approaches as specified in FAA Handbook 7110.65.

At some ATC facilities, particularly during peak periods of traffic, control positions not previously listed have been established to provide better service to aircraft and to relieve controller workload.

One such position is the Clearance Delivery Position. Figure 13-2 is a typical Clearance Delivery Position. The primary function of this position is as the name implies—to relay flight clearances received from the local ARTCC to aircraft prior to flight. Normally, a discrete radio frequency is used and the clearance is delivered to the aircraft prior to receiving taxi instructions.

Conversely, during slack traffic periods some of the operating positions may be combined to allow one controller to perform the duties normally required of two controllers.

Dependent upon local operating conditions, other supplementary control positions may be established; information required to qualify at the various control positions will be included in the ATC facility training manual published by the facility to which you are assigned.

EXERCISE

In exercise items 13-1 through 13-6, match the duties or responsibilities listed in column A with the billet or controller positions listed in column B. Items listed in column B may be used more than once or not at all.

A	B
13-1. Providing radar air traffic control services until the aircraft reaches approach minimums or is handed off to a PAR controller.	a. Radar Branch Manager
13-2. Monitoring nonradar precision approaches.	b. Radar Supervisor
13-3. Operating ATIS equipment.	c. Approach Controller
13-4. Recording equipment outages and action taken to correct discrepancies.	d. Departure Controller
13-5. Relaying IFR en route flight clearances received from ARTCC.	e. Arrival Controller
13-6. Determining the sequencing of arriving aircraft.	f. Flight data position
	g. Final Controller
	h. Clearance delivery

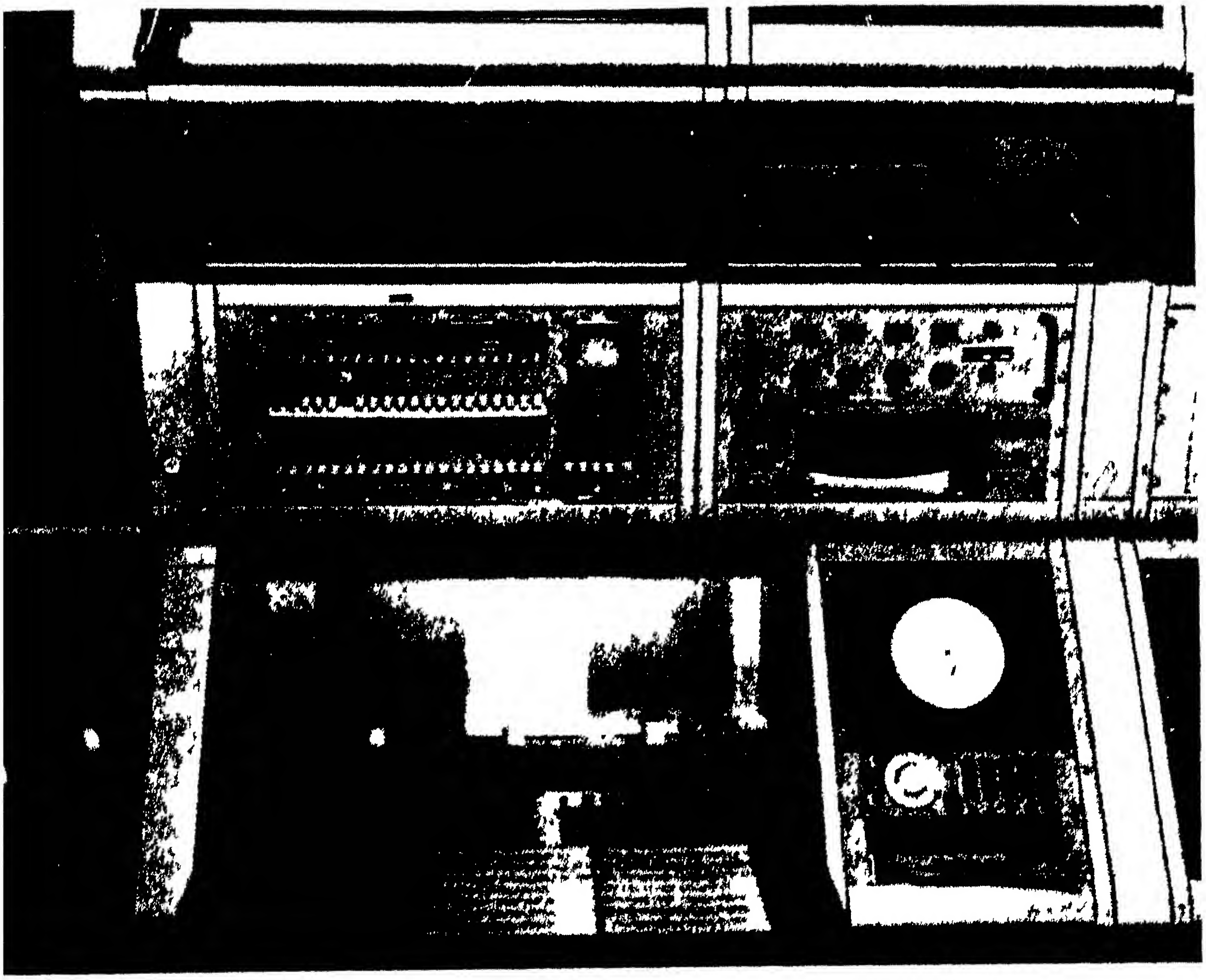

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Figure 13-2.—Clearance Delivery Position.

DAR PROCEDURE

Ƭhe radar procedures contained in this chapter ɜrally pertain to the ATC program ashore. ic control procedures apply to all areas of ır air traffic control; however, detailed ɔedures for shipboard operations are contained ꞉hapter 14 and the CV or LPH NATOPS ıual.

You, as a radar controller, must be person- satisfied that the radar presentation and the ipment performance are adequate for the serv- to be provided before attempting to provide ı service.

Upon assuming responsibility for a control position, you should check radar alignment. This may be accomplished by assuring that the video map or map overlay in use is properly aligned relative to the true geographic position, or by correlating a permanent target of known range and azimuth with the radar display. A target in each quadrant should be checked where possible. A brief check should again be made at various times throughout your watch to ensure accuracy of the radar.

When radar mapping is not available, you are limited to separating identified aircraft targets, vectoring aircraft to intercept a PAR final

approach course, and providing service in areas that ensure no conflict with traffic on airways or other ATC areas of jurisdiction.

We have said it before, but it's worth repeating: Provide radar service only if you are personally satisfied that the radar presentation and equipment performance is adequate for the service which you will provide. If not, then use the conventional nonradar procedures which were discussed in chapter 11. The following general discussion touches most established procedures associated with radar operations. Some items serve as a review for you whereas others are new material.

RADAR IDENTIFICATION

Learning objective: **State the appropriate action(s) to be taken in response to radar identification procedures.**

Before you provide radar service, you must establish the identification of the aircraft involved. You have two means of doing this: (1) by the primary or "skin paint" return and associated methods or (2) by the secondary beacon return and its associated methods.

Primary Return

When identifying a primary target, use one of the following three methods:

1. Observe a target whose position with respect to a fix displayed on the scope corresponds with a direct position report received from the pilot. This fix may be on a video map or map overlay, a permanent echo, or a visual reporting point whose range and azimuth has been accurately determined. In addition, the observed track of the aircraft must be consistent with the reported heading or route of flight.

2. Correlate a pilot reported radial/distance with the center of the radar sweep (main bang). This method may be used only if a TACAN/VORTAC is located within 6,000 feet of the radar antenna.

3. Observe a target making an identifying turn or turns of 30° or more, provided both of the following conditions exist:

a. The pilot has reported the aircraft's position and it is within coverage of your radar and within the coverage of the area you are displaying. This is not applicable if you are trying to locate a lost aircraft.

b. Only one aircraft is observed making the turns.

Secondary Return

When using secondary beacon returns to identify a target, use one of the following three methods:

1. Request the pilot to activate the "IDENT" feature of the aircraft transponder and observe the identification display.

2. Request the pilot to change the aircraft's transponder to a specific beacon code and then observe the target display change.

3. Request the pilot to change the aircraft's transponder to "STANDBY". After you observe the display target disappear, for a sufficient time to be assured that the disappearance was the result of activating the standby feature, request the pilot return the transponder to "NORMAL" operation.

Where circumstances are present to cause doubt as to target identification, you should use more than one method to establish radar identification.

Position Information

Inform the pilot of the aircraft's position whenever radar identification is established by means of either identifying turns or secondary radar beacon procedures. It is not necessary to provide position information to the pilot when radar identification is established by position/fix correlation, because obviously the pilot knows exactly what his position is.

Identification Status

Inform the pilot of "RADAR CONTACT" whenever any of the following two conditions exist:

1. After initial identification within the ATC system.

2. After identification is reestablished with an aircraft after either losing radar contact or radar service having been previously terminated with the aircraft. Inform the pilot of "RADAR CONTACT LOST" and, if required, issue alternate instructions when the identity or position of a radar-identified aircraft is in doubt or the target is unusable.

NOTE: The general definition of a minimum usable target is one where the return is not missed on more than two consecutive scans. From the final approach fix to the missed approach point, a target should normally be received on every scan.

Radar Service Terminated

RADAR SERVICE TERMINATED is a term used by ATC to inform a pilot that he will no longer be provided any of the services that could be received while under radar contact. Radar service is automatically terminated and the pilot is not advised of termination in the following cases:

1. An aircraft cancels its IFR flight plan, except within a Terminal Control Area (TCA), Terminal Radar Service Area (TRSA), or where Stage II service is provided.

2. At the completion of a radar approach.

3. When an arriving aircraft receiving radar services is advised to contact tower.

4. When an aircraft conducting a visual approach or contact approach is advised to contact tower.

5. When an aircraft making an instrument approach has landed or the tower has the aircraft in sight, whichever occurs first.

EXERCISE

13-7. You are required to inform the pilot of "radar contact" upon ________ or ________ into the ATC system.

13-8. Position information is provided to all arriving aircraft which are identified by ________ or ________.

13-9. It is/is not necessary to advise the pilot of radar service termination if the aircraft makes a precision radar approach.

13-10. Applying the fix correlation method of identifying an aircraft for radar service, a pilot advises you of his position in relation to a certain fix, which is being video mapped on your scope. Observing this fix, you see a target. Is this radar contact? Explain.

RADAR VECTORS

Learning objective: **Given pertinent questions concerning radar vectoring, supply brief answers.**

Vectoring Application

The first thing you should know is that vectoring of aircraft is generally limited to controlled airspace—your own controlled airspace. There are exceptions. For example, when you receive a handoff outside your area, you may request permission from the transferring controller to vector the aircraft prior to its reaching the boundary

of your area. If an agreement is reached, you may vector. However, an aircraft outside of controlled airspace is never vectored without the pilot making a direct request and sometimes not then, as we will see later.

Vector aircraft when it is necessary for separation or for noise abatement, when there is an operational advantage, or when requested by the pilot. Vectoring an arriving IFR aircraft is routine. The pilot is expected to advise you if he desires to make a full instrument approach without being vectored. However, vector a VFR aircraft, other than special VFR, only when:

1. The pilot requests the vector.
2. You suggest the vector and the pilot concurs.
3. Stage I, II, or III radar service is available.
4. In your judgement, the vector is necessary for air safety.

NOTE: VFR aircraft may be vectored regardless of their altitude. It is the pilot's responsibility to maintain terrain, obstruction, and cloud clearance.

Do not vector any aircraft for the purpose of avoiding other air traffic unless the aircraft to be vectored is within the airspace for which you have control jurisdiction. In addition, provide a vector to avoid traffic only if the pilot requests the vector.

Vector Methods

Vector aircraft by using one of the following two methods:

1. Specify the direction of turn and magnetic heading to be flown after completion of the turn. Example: TURN LEFT/RIGHT HEADING (degrees).

2. Specify that it will be a no-gyro vector and then specify the direction to turn and when to stop turning. Example: TURN LEFT/RIGHT (Pause) STOP TURN.

When the heading of the aircraft is unknown and there isn't time to obtain the heading, you may specify, in group form, the number of degrees to turn and the direction. Example: TURN THIRTY DEGREES LEFT/RIGHT.

You may also elect to specify the magnetic heading for the pilot to fly, e.g. FLY HEADING (degrees), or specify that the present heading be flown, e.g., FLY PRESENT HEADING, or specify the heading to depart a fix, e.g., DEPART (fix) HEADING (degrees). These are all forms of vectoring.

Inform the pilot whenever a vector will take the aircraft across the NAVAID final approach course to which you told the pilot he was being vectored, and state the reason for the action. You might state, EXPECT VECTOR ACROSS FINAL APPROACH COURSE FOR SPACING.

EXERCISE

13-11. The most common method of vectoring an aircraft is to specify to the pilot the ________ and ________.

13-12. What should you tell the pilot if you intend to vector him across the final approach course?

13-13. When should you NOT vector an aircraft?

13-14. Give an example of phraseology you could use if it were necessary to turn an aircraft immediately and you did not know the aircraft's heading.

RADAR HANDOFFS

Learning Objective: **Distinguish between correct and incorrect procedures concerned with radar handoffs.**

As we have pointed out from time to time, no one controller controls a given flight from takeoff

to landing, but rather several controllers, each responsible for a certain area, control the flight at different times. Therefore, the process of transferring control of the aircraft from one controller to another must be precise and accurate.

Interfacility and intrafacility radar handoffs are *required in all areas of radar surveillance*. The transferring controller is required to complete the handoff or obtain the receiving controller's approval before the flight enters the airspace controlled by the receiving controller. This is mandatory and the only exceptions are those instances where it is not feasible to make radar handoffs and specific guidance is covered by Letter of Agreement, or the receiving and transferring controllers reach a specific agreement at the time of coordination.

Identification Transfer

Transfer the identification of the aircraft by using one of the following two methods:

1. Physically point out the target to the receiving controller.
2. Inform the receiving controller of the following: The distance and bearing of the target from a fix or transfer point shown on both scope displays or the distance and relative position to a target previously identified in conjunction with consecutive handoffs during the same coordination period.

If the aircraft is transponder equipped, apply (1) or (2) above, and, if requested by the receiving controller, require the pilot to IDENT. In addition to (1) or (2) above, inform the receiving controller of the observed track of the aircraft unless it is already known.

You may consider a target being transferred to you as identified when any of the following conditions exist:

1. The target has been pointed out to you.
2. The target corresponds with the position and track information provided by the transferring controller for a nonbeacon target.
3. The target is the only one observed which corresponds with the position, track, and radar beacon information provided by the transferring controller.

NOTE: Should you have any doubt as to the identity of a target, do not hesitate to require additional information or use other methods of identification.

After you identify the target being transferred, *state the aircraft's identification* and inform the transferring controller of radar contact; for example, GOLF HOTEL ZERO-ONE, RADAR CONTACT. If appropriate, issue frequency and beacon code change information. The Air Traffic Control Handbook 7110.65 has a complete section on standard operating practices (SOP) for the transfer of radar identification and its associated coordination.

Communications Transfer

Transfer communications before an aircraft enters the receiving controller's area unless a delay has been previously coordinated. It is desired that initiation of transfer be at the time of handoff.

Control Transfer

As was pointed out during our discussion on vectoring, assume control of an aircraft only after it is in your area of responsibility unless specific agreements were coordinated at the handoff time. When you transfer control of an aircraft while it is within your area, issue any restrictions to the receiving controller that may be necessary to provide separation with other aircraft within your area.

Confirmation

After you accept a handoff from another facility, confirm the identity of a nonbeacon target by advising the aircraft of its position. If, on the other hand, it is a beacon-equipped aircraft, you should observe an IDENT, a beacon code change, or a standby action. If any of these were accomplished during the handoff, they need not be repeated. These confirmation procedures are not necessary when GCAs are providing final approaches only and the traffic is being sequenced by the parent approach control.

EXERCISE

In the blanks provided, enter T (true) or F (false) for each of these statements.

13-15. ____ A target that has been physically pointed out to you on your scope requires no further method of transfer identification.

13-16. ____ An example of properly informing the transferring controller that you have identified an aircraft and will accept responsibility for it is "Radar Contact, Alpha Kilo Two-Two."

13-17. ____ Normally, the transferring controller must complete the handoff before the transferred aircraft crosses the boundary into the next area.

13-18. ____ Assume that you are accepting a handoff and the transferring controller has the pilot of the transferring aircraft IDENT for you. It will be necessary for you to require the pilot to IDENT again as soon as you are in direct radio contact with the pilot.

APPROACH INFORMATION BY APPROACH CONTROL FACILITIES

Learning Objective: **Tell when an approach controller needs to issue given types of information to an arriving aircraft.**

As soon as possible after you establish radio contact with an arriving aircraft, provide the pilot with the following information (except you may omit information contained in the ATIS broadcast when the pilot states the proper ATIS code):

1. An approach clearance or type of approach to expect if two or more approaches are published and the clearance limit does not indicate which approach procedure will be assigned.
2. Runway in use, if different from the runway to which the approach will be made.
3. Wind.
4. Ceiling and visibility, if either is below VFR or the ceiling is below the highest circling minimum even though above VFR minimums.
5. Altimeter setting.

As soon as possible after first radio contact and as changes occur, advise the pilot of any abnormal operation of approach and landing aids and any airport conditions which might affect an approach or landing. Of course, any of this information that is contained in ATIS may be omitted when the pilot states the proper ATIS code.

When weather reports indicate that an aircraft will likely encounter IFR weather conditions during the approach, take the following action as soon as possible after establishing radar identification and radio communications (may be omitted after the first approach when successive approaches are made and the instructions remain the same). Advise the pilot that if radio communications are lost between you and him, for a specific time interval not to exceed 1 minute while being vectored to the final approach course, and for a period of 15 seconds on a surveillance final approach, or 5 seconds on a PAR final approach, to:

- Attempt to contact you on another frequency (tell him the frequency) or a specific tower frequency, and to proceed VFR if able; if not able to proceed VFR, to proceed with a specific nonradar approach, or give specific alternate instructions for the pilot to follow, such as holding instructions.

The pilot is responsible for determining the adequacy of the lost communications procedures you issue. If the pilot states he cannot accept the

procedures, request he advise you of what he will do in the event of lost communications. As a final note, make sure that you get the entire procedure he will follow and not half the facts. After you have lost radio contact, it is too late to get any more information.

EXERCISE

13-19. Briefly explain when an approach controller needs to issue lost communications procedures to an arriving aircraft.

13-20. When is it necessary for an approach controller to issue ceiling and visibility to an arriving aircraft?

At times, it is impossible for the approach controller to vector every aircraft the moment he acquires control or even allow the aircraft to commence an instrument approach. Therefore, holding instructions become necessary.

HOLDING PROCEDURES

Learning Objective: **Name the categories of holding instructions and how they are different.**

If a delay is anticipated and the holding pattern is not charted, issue both of the following items:

1. General holding instructions or, if the pilot requests or you think it to be necessary, detailed holding instructions. Both are described later. Issue one of these forms of instruction at least 5 minutes before the aircraft is estimated to reach the clearance limit.
2. The time at which the pilot can expect to receive further clearance (EFC). Issue a time check to the pilot before issuing the EFC. If the holding pattern is charted, only the direction from the fix the pilot is to hold need be given. Of course, an EFC is required and instructions need to be given at least 5 minutes before the pilot reaches the clearance limit.

General Holding Instructions

For general holding instructions, issue:

1. Direction to hold from the fix.
2. The holding fix.
3. Radial, course, bearing, airway, or jet route on which the pilot is to hold.
4. Outbound leg length in miles, if DME is to be used.
5. If left turns are to be made, specify LEFT TURNS, otherwise it is assumed that right turns, being standard, are to be made. An example of general holding instructions is:

HOLD EAST OF TWO-ZERO MILE FIX ON POPE TACAN ZERO NINE ZERO RADIAL, FIVE MILE LEG, LEFT TURNS.

Detailed Holding Instructions

For detailed holding instructions, issue the same as for general holding but always specify leg length in either minutes or miles DME and the direction of turns.

As an additional service, to the extent you are able to fit it into duties of a higher priority, provide radar surveillance of holding patterns displayed on your scope by video mapping or map overlays. Attempt to detect any aircraft straying outside of the holding pattern and assist the pilot in returning to the assigned holding pattern airspace.

Assuming no delay is necessary, and therefore no holding of aircraft, the next step is to vector the aircraft to the approach gate. A vector, you should recall, is defined as: controlling the flight of an aircraft by issuance of a series of instructions giving the necessary directional changes needed to make good a desired flightpath. Normally, this path is the most direct route from

pickup point to the approach gate consistent with the traffic flow.

EXERCISE

13-21. What are the two categories of holding instructions?

13-22. How do the categories differ?

13-23. When issuing holding instructions, what two other items need to be issued?

13-24. Holding instructions should be issued at least _______ minutes prior to an aircraft reaching its clearance limit.

ARRIVAL SEPARATION STANDARDS

Instant and accurate radar position information provides you with a distinct advantage over the conventional air traffic controller. Nonradar control is based on pilot reports. With radar, you follow an aircraft's flightpath and issue control instructions to properly space and separate your traffic. You are therefore able to sequence your aircraft for an approach and landing with minimum delay.

APPLICATION OF RADAR SEPARATIONS

Learning Objective: **Identify appropriate minimum radar separation standards.**

Radar separation may be applied between:

1. Radar-identified aircraft.
2. An aircraft taking off and another radar-identified aircraft, provided that the departure will be radar identified within 1 mile of the runway end.

Radar separation may also be applied between a radar-identified aircraft and an IFR aircraft not radar identified when the radar-identified aircraft is climbing or descending through the altitude of the latter. However, application of this provision of the rules is subject to the following conditions.

1. The performance of the primary radar system is adequate and primary radar targets are being displayed on the scope being used.
2. Radar separation is maintained from all observed primary and radar beacon targets until nonradar separation is established from the unidentified IFR aircraft.
3. The airspace in which the separation is applied is not less than 6 miles (10 miles if 40 miles or more from the antenna site) from the edge of the radar display.
4. Flight data on the unidentified IFR aircraft indicates it is a type which can be expected to give an adequate primary return in the area where separation is applied.
5. When the two aircraft involved are on the same relative heading, the radar-identified aircraft is to be vectored on a flightpath that is different from the unidentified aircraft before the former is cleared to climb or descend.

Since primary targets appear to be elliptical and beacon targets may not always be exact, you must determine a specific portion of each target on which to base your separation. Therefore, apply radar separation between the:

1. Centers of the primary targets. However, never allow a primary target to touch another primary target or a beacon control slash.
2. Ends of beacon control slashes.
3. Ends of a beacon control slash and the center of a primary target.

Normally, a primary return must be present to provide radar services. However, you may use beacon targets for separation purposes if the beacon range accuracy is verified by correlation of the beacon and primary target of the same

aircraft to ensure that they coincide. If the beacon range accuracy cannot be verified, you may use beacon targets only for traffic information.

SEPARATION MINIMA

Separate aircraft by the following:

- If less than 40 miles from the radar antenna—3 miles.
- If 40 miles or more from the radar antenna—5 miles.

NOTE: Separate a formation flight from other aircraft by adding 1 mile to the appropriate radar separation and by adding 2 miles to the standard separation if two formations are involved.

Adjacent Airspace

Unless coordination has been effected, separate radar-controlled aircraft from the boundary of adjacent airspace in which radar separation is also being used by the following minima:

- When less than 40 miles from the radar antenna site—1 1/2 miles.
- When 40 miles or more from the radar antenna site—2 1/2 miles.

Separate radar-controlled aircraft from the boundary of adjacent airspace in which nonradar separation is being used by these minima:

- When less than 40 miles from the radar antenna site—3 miles.
- When 40 miles or more from the antenna site—5 miles.

Edge of Scope

Separate a radar-controlled aircraft climbing or descending through the altitude of an aircraft that was tracked to the edge of your scope by these minima:

- When less than 40 miles from the antenna site—3 miles.
- When 40 miles or more from the antenna site—5 miles.

Obstructions

Within 40 miles of the antenna site, separate radar-controlled aircraft from prominent obstructions shown on the radarscope by video mapping, map overlay, or permanent echo by either a minimum of 3 miles or vertically. You may discontinue vertical separation from permanent echos after you observe the aircraft to have passed the obstruction.

Special Heavy and Jumbo Jet Radar Separation Minima

To avoid the wake turbulence of aircraft operating directly behind at the same altitude or at less than 1000 feet below a heavy jet, separate IFR/VFR radar traffic by the following minima:

- Heavy following heavy—4 miles.
- Nonheavy following heavy—5 miles.

NOTE: USAF separate aircraft other than heavy jets operating behind a B-747, DC-10, L-1011, or C-5A by 10 miles or 4 minutes.

EXERCISE

13-25. Assume that you are vectoring two standard formation flights of F-18s within 40 miles of the radar antenna. What is the minimum horizontal radar separation?

13-26. Assume that you are vectoring an aircraft. At 25 miles from the radar antenna, the aircraft is 2 miles from the boundary line of another area in which radar service is also being used. Is your aircraft properly separated from the boundary?

13-27. If you vector an aircraft for horizontal separation from a permanent echo, what is the minimum acceptable distance?

13-28. List the minimum separation standards associated with radar separation between aircraft because of wake turbulence.

RADAR APPROACHES

There are two basic types of radar approaches: the precision approach (PAR) and the surveillance approach (ASR). A PAR approach involves the use of precision radar equipment; a surveillance approach uses the search radar. These approaches are usually made toward the landing runway. However, in some cases an aircraft requires only guidance through an overcast, and then proceeds on its own to the runway. These are also classified and discussed as radar approaches. Although they are not entirely radar-controlled approaches, we do discuss various aspects of these approaches in this section. Last, a radar approach may be given to any aircraft upon request or to expedite the traffic flow.

PRECISION APPROACHES

Learning Objective: **State appropriate control actions you should take at given times in PAR and ASR approaches and the procedures used in circling and visual approaches.**

In the precision approach, precise control instructions are issued to the pilot so that he may align the aircraft on the glidepath and course line. The first step after the aircraft has been vectored to the PAR final approach course is for the final controller to establish radio communications with the pilot. On initial contact, the final controller asks, "This is (name of facility) final controller, how do you hear me?" After contact has been established, the pilot is instructed, "Do not acknowledge further transmissions." From this point on, guidance information is issued to align the aircraft on both the course line and glidepath. Frequently inform the aircraft of any deviation from either, such as "Slightly/well above/below glidepath and slightly/well left/right of course." You may also add to this trend information such as, "Going rapidly/slowly, left/right of course, or above/below glidepath."

Inform the pilot 10 to 30 seconds before the aircraft reaches the glidepath, "Approaching Glidepath," and that the aircraft's wheels should be down. When the aircraft reaches the glidepath, instruct the pilot to "Begin descent." From this point on, issue instructions to keep the target descending on the glidepath until the aircraft reaches the published decision height and inform the pilot, "At decision height." At this point, the pilot should have visual clues to the runway; you, however, continue to provide advisory course and glidepath information to the pilot until the aircraft passes over the landing threshold and you advise the pilot, "Over landing threshold."

In addition, there are two other things you need to provide the pilot during the approach. They are distance from touchdown and when the aircraft passes over the approach lights. Inform the pilot of the aircraft's distance from touchdown at least once each mile on final approach.

Approach Abnormalities

Advise the pilot to "execute a missed approach if the runway environment is not in sight" when any of the following occur:

1. Safety limits are exceeded or radical target deviations are observed, or
2. The position or identification of the aircraft is in doubt, or,
3. Radar contact is lost or a malfunctioning radar is suspected.

You may have to provide the pilot with specific missed approach instructions at this point. Also included in this category are instructions issued by the tower because of airport conditions or the traffic situation.

Elevation Failure

If, during the approach, the elevation (glidepath) portion of the PAR display fails, discontinue guidance. Tell the pilot to take over visually or, if unable, to execute a missed approach. Specific phraseology and procedures covering this situation are in ATC Handbook 7110.65.

SURVEILLANCE APPROACHES

During a surveillance approach, only range and azimuth information is supplied to the pilot. Descent is accomplished by the pilot descending at a specific time to a predetermined altitude, known as the Minimum Descent Altitude (MDA). Issue advance notification of where this descent will begin and issue the straight-in MDA to those aircraft making a straight-in approach. For example, "Prepare to descend in (number) mile(s), published minimum descent altitude (altitude)." Also, issue a wheels down advisory at this time.

The pilot may request that to be provided with recommended altitudes on final. If recommended altitudes are requested, inform the pilot that recommended altitudes which are at or above the published MDA will be given each mile on final. Recommended altitudes are determined locally, based on the descent gradient required to reach the MDA at the proper range. Check with your trainer for these.

When the aircraft reaches the descent point, issue one of the following as appropriate:

1. Unless a descent restriction exists, advise the pilot to descend to the MDA.
2. When a descent restriction exists, specify to the pilot to descend to the restricted altitude. After the aircraft has passed the point limiting descent, advise the pilot to continue descent to the MDA.

Final approach guidance is normally continued until the approach is terminated at the missed approach point (MAP). Each runway to which a surveillance approach can be made has an established MAP. Guidance may be terminated by pilot request or when, in your opinion, continuation to the MAP is unsafe or questionable. At the beginning of the approach, you may request that the pilot report the runway or approach lights in sight. When you have made such a request and the approach is terminated because of any of the three items mentioned above and the pilot has reported the runway or lights to be in sight, then advise the pilot of the aircraft's range and to proceed visually. If, however, the pilot has not reported the runway or lights in sight, or you made no such request, advise the pilot of the aircraft's position and instruct the pilot to execute a missed approach, if the runway or approach lights are not in sight.

CIRCLING APPROACHES

A circling approach is a visual maneuver. In the sense we approach it as a radar approach, we imply that radar may be used to position the aircraft so that the pilot makes visual contact with the airport/runway environment at some point and completes the approach visually to the runway in use.

Always include, as part of the approach information, instructions to "Circle to runway (number)" when this is the case. For example, "This will be a PAR/surveillance approach to runway (number), circle to runway (number)." In most cases, an approach involving circling is made following the same guidelines established for PAR or surveillance approaches, except that in the case of an ASR approach, the pilot descends to the circling MDA instead of the straight-in MDA.

VISUAL APPROACHES

A visual approach is a procedure where you vector an aircraft to the VFR traffic pattern and clear the pilot to complete the remainder of the approach visually. To use this procedure, the following preconditions must be met:

1. The reported ceiling at the airport must be at least 500 feet above the minimum radar vectoring altitude and the visibility at least 3 miles.
2. The aircraft is at the minimum vectoring altitude or you have obtained reports indicating that descent to the minimum vectoring altitude can be made in VFR conditions.
3. You provide radar separation from any preceding IFR aircraft until visual separation can

be provided. Continue flight-following and provide traffic information until the pilot is instructed to contact the tower.

Issue clearance for a visual approach when one of the following conditions exists: If the aircraft is not following another aircraft that has been sequenced by approach control, issue clearance for a visual approach when the aircraft reports the field in sight and the tower controller has been informed of its position. Then instruct the aircraft to contact the tower. If the aircraft is following a preceding aircraft (IFR or VFR) which has been sequenced by approach control, issue clearance for a visual approach when:

1. The succeeding aircraft reports sighting the preceding aircraft.

2. The tower controller is informed of the succeeding aircraft's position in the approach sequence.

3. The succeeding aircraft is instructed to follow the preceding aircraft.

The tower controller and the approach controller coordinate to determine the point at which the tower will assume control of the aircraft. This allows the tower controller sufficient time to properly establish a landing sequence.

EXERCISE

13-29. At what point should you inform the pilot making a PAR that the aircraft is approaching the glidepath?

13-30. After you have informed the pilot that the aircraft has reached the "decision height" for the approach, do you provide further control instructions? Explain.

13-31. If the PAR elevation display fails during an approach, what should you do?

13-32. On an ASR approach, when the aircraft reaches the MAP and you have previously requested that the pilot report the runway or approach lights in sight, but he has not, state in your words what you should tell the pilot.

13-33. State the difference between a straight-in ASR approach and as ASR approach in which the aircraft will circle and land on another runway.

13-34. When an aircraft will make a visual approach, to what point is the aircraft vectored and when is the aircraft normally changed to the tower controller frequency?

13-35. In order to apply visual procedures, what minimum weather conditions must prevail at the airport?

RADAR DEPARTURES

One of the big advantages of radar is its ability to provide a more efficient use of the runway. Because you can see exactly where arriving traffic is at any moment, departing aircraft have a better chance of not being delayed because of uncertainty of the location of arriving traffic. While the procedures governing departure operations are less complex than arrivals, the successful mixing of departures and arrivals requires the utmost attention to duty and procedures.

Learning Objective: **State appropriate procedures for handling radar departures.**

If you intend to identify the departure immediately after takeoff and vector the aircraft to some point, then before the aircraft takes off you need to assign the appropriate radar beacon code and to issue initial heading instructions.

Normally, these instructions are given to the local controller to relay to the pilot at the time the local controller requests a release of the aircraft for departure. The pilot is either instructed to "Fly runway heading" or to "Turn left/right, heading (degrees)." A purpose for the heading is not necessary since pilots operating in a radar environment associate assigned headings with vectors to their planned route of flight. If, on the other hand, a SID (Standard Instrument Departure) was assigned and you do not intend to vector the departure, initial heading instructions are not necessary.

RADAR IDENTIFICATION METHODS

Any of the methods we previously discussed concerning arrivals may be applied to departures. In addition, a departure may be considered identified when it is observed within 1 mile of the takeoff end of the runway. However, care must be exercised here because of the possibility of misidentification because of a VFR departure preceding the IFR traffic you released. When a a turbojet departure checks in on your frequency before departing, it is a good practice to tell the pilot to report airborne. When he does and you see a target just airborne off the runway, you can be reasonably sure that it is your traffic. If doubt exists, use other methods. Other types of aircraft are changed to the departure control frequency after they are airborne and usually require another method of identification.

DEPARTURE/ARRIVAL SEPARATION STANDARDS

Separate a departing aircraft from an arriving aircraft on final approach by a minimum of 2 miles, provided the separation will increase to a minimum of 3 miles within 1 minute after the departure takes off. Increase this separation to 5 miles within 1 minute if the radar antenna is 40 miles or more from the area in which separation is being applied.

Should you be assigned to an airport which has parallel runways, simultaneous operations are authorized, provided that the following conditions exist:

1. If the landing thresholds are even, the runway centerlines are separated by at least 3,500 feet. (See figure 13-3.)

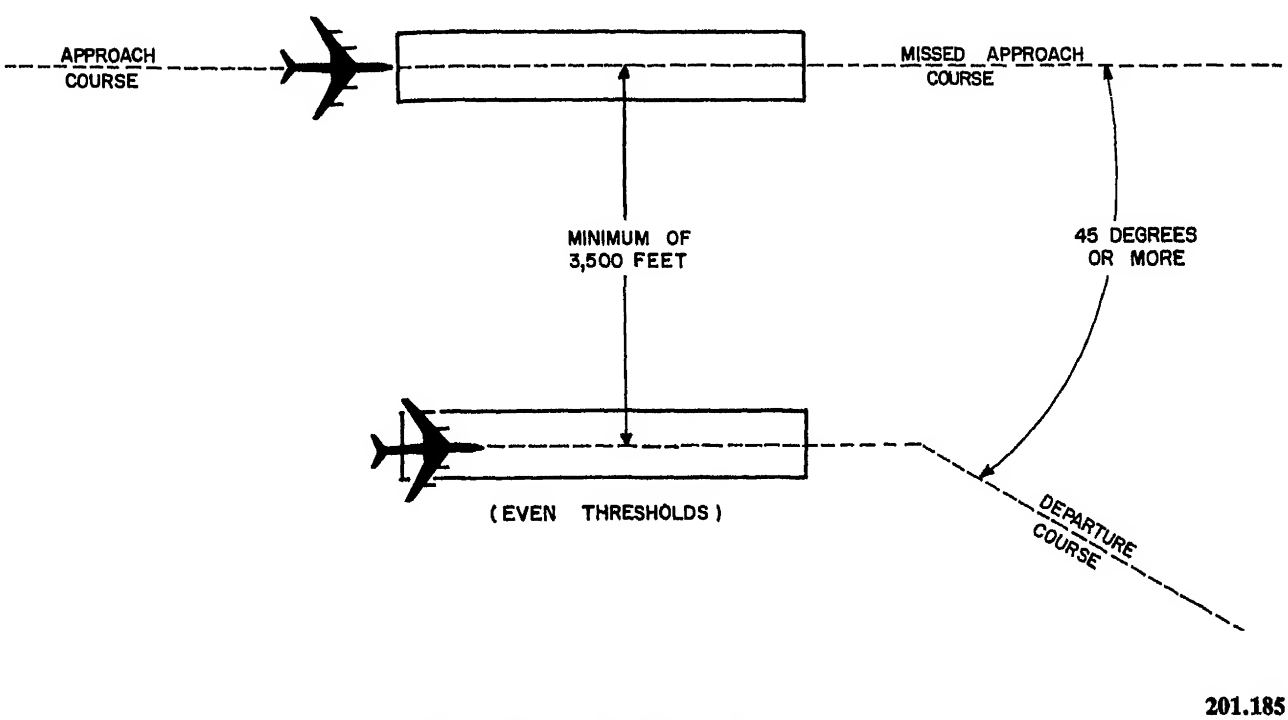

Figure 13-3.—Simultaneous operations from parallel, even threshold runways.

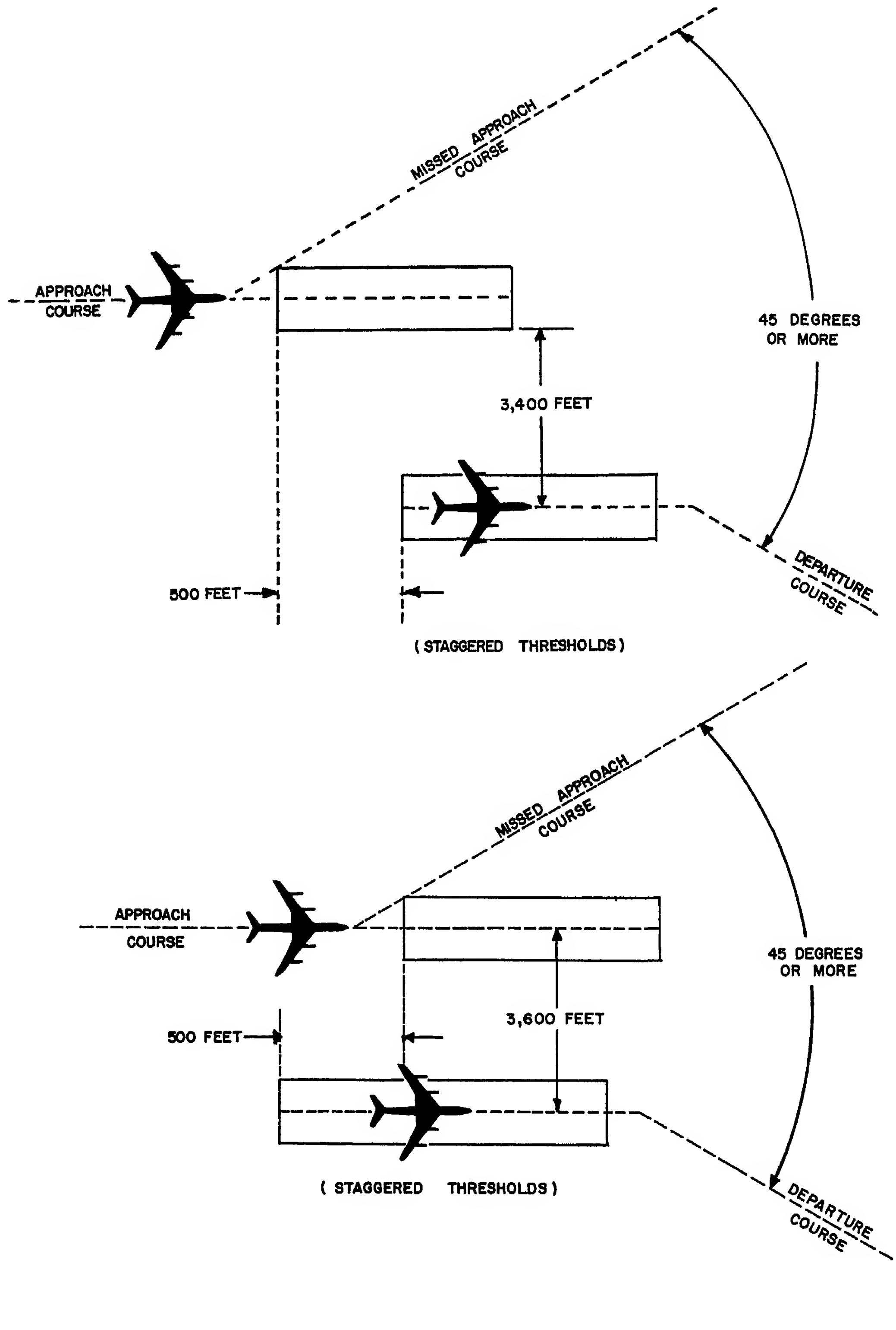

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Figure 13-4.—Simultaneous operations from parallel, staggered threshold runways.

If the landing thresholds are staggered and ›f the following conditions is met:

a. The approach is made to the runway ;st the arriving aircraft, the runway rlines are laterally separated by at least ı feet, and the thresholds are horizontally ered at least 500 feet for each 100 feet of rline separation below 3,500 feet. (See figure)

b. If the approach is made to the runway est from the arriving aircraft, the runway rline separation exceeds 3,500 feet by at least 'eet for each 500 feet of threshold stagger ıce. (See figure 13-4.)

. The departure course will diverge ;diately after takeoff from the missed ›ach course by at least 45° until minimum · separation is achieved and can be tained.

Departing aircraft that have not com- ;ed takeoff are held, or appropriate ınces issued to those committed to take off, an arriving aircraft is observed to deviate the approach/missed approach course suf- ıtly to cause a potential conflict.

imultaneous operations may be authorized ›nintersecting, diverging runways (see figure provided that the following conditions exist:

. The departure course upon or immediately takeoff diverges from the missed approach ;e by at least 45° until minimum radar separa- is achieved and can be maintained.

. The distance between the centerline or ded centerline of the landing runway and the :rline of the takeoff runway (measured from ›oint where the takeoff is commenced) is as ws:

a. 1,000 feet if the runways diverge by at least 30°.

b. 2,000 feet if the runways diverge by 15° to 29° inclusive.

c. 3,500 feet if the runways diverge by 14° or less.

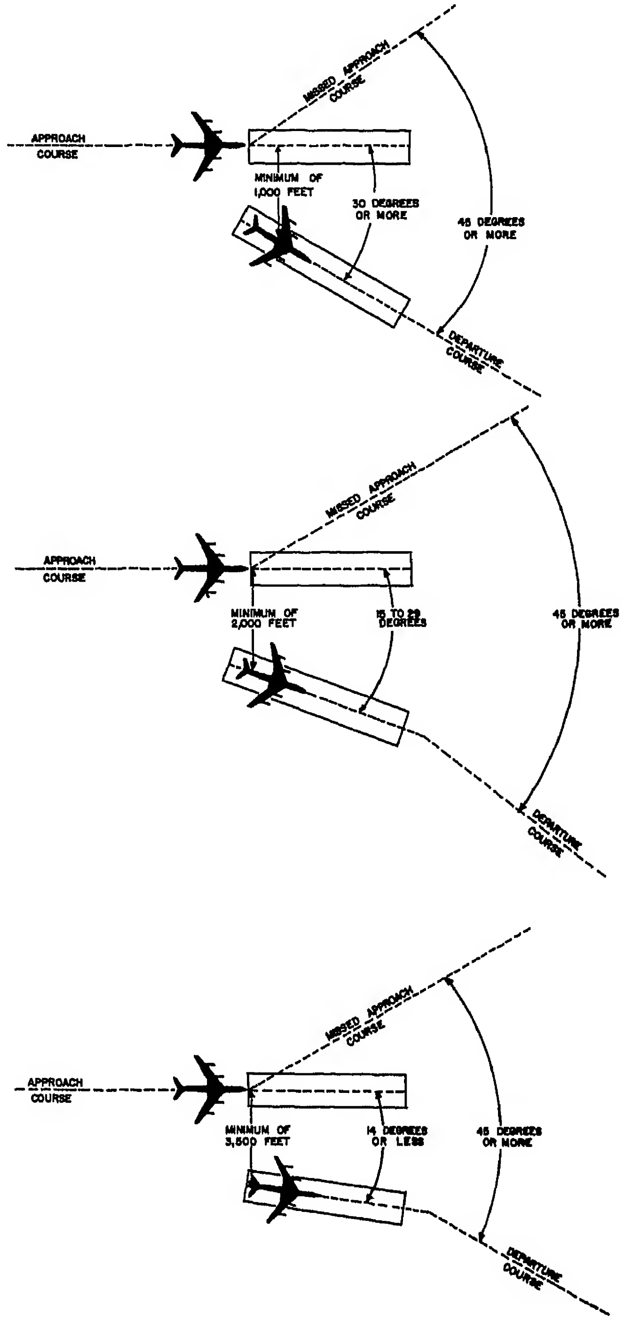

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Figure 13-5.—Simultaneous operations from diverging, nonintersecting runways.

3. Departing aircraft that have not commenced takeoff are held, or appropriate clearances issued to those committed to takeoff, when an arriving aircraft is observed to deviate from the approach/missed approach course sufficiently to cause a potential conflict.

VECTORS BELOW THE MINIMUM VECTORING ALTITUDE

You may vector a departing aircraft before it reaches the minimum radar-vectoring altitude provided:

1. It is within 40 miles of the antenna site.

2. Separation from prominent obstructions shown on the radarscope is applied in accordance with the following:

a. If the flightpath is 3 miles or more from the obstruction and the aircraft is climbing to an altitude at least 1000 feet above the obstruction, vector the aircraft so as to maintain this 3 miles separation until the aircraft reports leaving an altitude above the obstruction.

b. If the flightpath would result in less than 3 miles lateral and the aircraft is climbing to an altitude 1000 feet above the obstruction, vector the aircraft so as to establish 3 miles minimum separation from the obstruction or until the pilot reports leaving an altitude above the obstruction.

SERVICE TERMINATION

If you vector a departure off a nonradar route for traffic reasons, you must reestablish the aircraft on the nonradar route or on an assigned heading which will intercept the route, fix, etc., within a reasonable distance and instruct the pilot to resume normal navigation, before you terminate service to the pilot. Of course, you may elect to hand the aircraft off to the center, and may be required by a Letter of Agreement to make a handoff. Barring this requirement, or your inability to effect the handoff, radar service may be terminated and the pilot instructed to contact the center.

EXERCISE

13-36. What is one method of identifying a radar departure that is not applicable to any other situation?

13-37. When do you need to issue initial heading instructions to a departure?

13-38. Can a departure be vectored before the aircraft reaches the minimum radar-vectoring altitude? Explain.

13-39. What is the minimum radar separation between an arriving aircraft and one departing if both are using the same runway?

EXPANDED AND ADDITIONAL RADAR SERVICES

In this section, we start with a discussion of Stages I, II, and III radar services, which are forms of expanded use of the terminal radar. After this discussion, we identify various forms of duties which are classified as additional duties.

EXPANDED SERVICES

Learning Objective: **Differentiate between the services provided through expanded radar programs and identify additional radar services.**

In addition to the use of radar for the control of IFR aircraft, three terminal radar programs have been established to provide radar service that includes VFR aircraft. The services provided by

this expanded radar coverage are called Stages I, II, and III, and are offered at specific terminal areas as identified in the IFR supplement. The amount of assistance given pilots is governed by the type of service your approach control facility provides and your workload at any given time. In this section, we discuss each service individually; but first let's discuss several points that are common to each of these services. Pilot participation is voluntary; however, all are encouraged to participate. Where radar advisory service is available, *it is mandatory that all USN aircraft* participate especially when VFR flight is required through high-density traffic areas. Pilots participating in these programs are not relieved of their responsibility to comply with Federal Aviation regulations. For example, pilots operating in basic VFR weather conditions must maintain terrain and obstruction clearances, see-and-avoid other VFR traffic, and remain in VFR flying conditions.

Stage I Service

This is the simplest service. It provides traffic information and limited vectoring service to VFR aircraft when the facility's workload permits. When Stage I is available, and it is desired by the pilot of an arriving VFR aircraft, he will contact approach control stating his position, altitude, and destination, and will request traffic information. Unless the pilot states "have numbers" or gives the appropriate ATIS code, you should issue runway and wind information and specify the time or place at which he is to contact the tower for further landing information. Based on your workload at this point, you have the option of radar identifying the aircraft and issuing detailed traffic information or of not identifying the aircraft and issuing only general traffic information. If your workload prevents you from issuing detailed traffic information, then do not identify the aircraft. Once identified, the pilot will expect complete traffic information, and good control technique dictates that you do just that. Provide limited vectoring service, upon pilot's request, or if you suggest it and he agrees. Radar service is automatically terminated when the pilot is told to contact the tower.

Stage II Service

The purpose of this service is to adjust the flow of arriving VFR and IFR aircraft into the traffic pattern in a safe and orderly manner. In addition to traffic information and vectoring, Stage II provides sequencing service to both VFR and IFR flights. Pilots of arriving aircraft desiring Stage II will contact the approach control *prior to* entering the area in which this service is provided and request radar service. Pilots who do not desire this service may be fitted in the landing sequence by the tower after coordination with approach control. The procedures for providing wind and runway information are the same as those described for Stage I, and traffic information is provided on a workload-permitting basis. When the traffic pattern is saturated, VFR flights may be instructed to hold over the initial reporting fix or a fix near the airport. IFR aircraft must be instructed to hold in accordance with IFR procedures. After radar contact is established, position VFR aircraft in the landing sequence by radar vectors or by instructing the pilot to join the traffic pattern at a specific point. Vector IFR flights to the VFR pattern and provide standard radar separation between IFR aircraft until such time as the aircraft is sequenced and the pilot sees the aircraft he is to follow. You need not provide standard radar separation between VFR or between VFR and IFR aircraft nor assign landing sequence numbers to any aircraft unless this responsibility has been delegated to you. But, do not forget that you are responsible for wake turbulence separation from heavy jet aircraft when you are vectoring IFR/VFR aircraft for separation. Once the flight (VFR or IFR) has been positioned in the landing sequence and the pilot reports sighting the preceding aircraft, instruct him to follow that aircraft. If the flight is on an IFR flight plan and weather conditions are VFR, he may be cleared for a visual approach. After the pilot has been instructed to follow a preceding aircraft, he should be told to contact the tower. At this time, inform the tower of the aircraft's position as radar service is automatically terminated. Departing VFR flights that have requested radar service should be given traffic information until radar contact is lost or the aircraft has reached the perimeter

of the area in which this service is provided. Pilots of aircraft transitting the area may receive traffic information on a workload-permitting basis.

Stage III Service

As mentioned previously, participation in this service is mandatory for USN aircraft. Civil and other military pilots are encouraged to participate on a voluntary basis. Stage III provides the following services within a terminal radar service area:

- Traffic information on observed, identified targets on a workload-permitting basis.
- Radar vectoring and sequencing of all IFR and participating VFR aircraft.
- Radar control of IFR traffic and radar advisories to nonparticipating VFR aircraft.
- Separation between all IFR and participating VFR aircraft.

IFR aircraft participating in Stage III will be given normal IFR service with additional emphasis on the provision of traffic advisories. Separation under Stage III is achieved primarily by radar in accordance with standard radar separation standards.

ADDITIONAL SERVICES

It is highly desirable that you provide additional services where possible. Some of these services include providing traffic, precipitation, chaff, or storm area information. Provide these services to the extent possible contingent on your capability to fit them into services of a higher priority.

The provisions of any of the following services are not mandatory because of the many factors which could prevent you from providing them. You have complete discretion for determining if you are able to provide or to continue to provide an additional service. You are not required to inform the pilot of why you cannot provide the additional service.

Traffic Information

This is an additional service—very high on the list. Traffic information should be issued to all radar identified aircraft unless the pilots request omission. When issuing traffic information, include the following items:

1. Azimuth of the traffic from the radar identified aircraft in terms of the 12-hour clock.
2. Distance in miles.
3. Direction in which the traffic is proceeding and/or the relative movement of the traffic, for example, crossing left to right or right to left, opposite direction, etc.
4. If known, the type of aircraft and its altitude.

EXAMPLE: TRAFFIC, THREE O'CLOCK, SEVEN MILES, WESTBOUND, DIVERGING, F-FOUR, FLIGHT LEVEL TWO FIVE ZERO.

Upon request of the pilot, vector the aircraft to avoid the observed traffic provided it is within your area of control jurisdiction. If you are not vectoring the aircraft to avoid the traffic and the pilot states that he does not see the traffic, inform him when the traffic is no longer a factor.

To aircraft that are not radar identified, provide the following information on known traffic:

1. Distance and direction from fix.
2. Direction in which traffic is proceeding.
3. If known, type of aircraft and its altitude.

EXAMPLE: TRAFFIC, ONE ZERO MILES EAST OF KENTON VOR SOUTHBOUND DC-EIGHT, FLIGHT LEVEL TWO ONE ZERO.

Weather and Chaff Information

Issue pertinent information on radar observed weather and chaff areas and suggest radar assistance in avoiding these areas. Provide this

assistance only after the pilot requests it. Issue weather and chaff information by stating its azimuth and distance from the aircraft.

Bird Activity Information

Issue advisory information on pilot reported or radar observed and pilot verified bird activity. Include in the advisory the position, species or size of the birds, if known, and their course and altitude. For example, "Flock of geese, one o'clock, seven miles, northbound, last reported at four thousand." Relay bird activity information to adjacent facilities and to the local Flight Service Station whenever it appears it will become a factor in their areas.

Merging Targets Information

Apply these procedures to all radar identified scheduled air carrier aircraft in all airspace environments except while they are holding in a holding pattern. To the extent possible, give this service priority over other additional services.

Issue radar traffic information to the aircraft when its target is likely to merge with another aircraft target unless the traffic is known to be separated by more than the minimum approved vertical separation. If the pilot requests and provided the aircraft is within the airspace for which you have control jurisdiction, vector the aircraft to avoid any target contact with the traffic.

Aircraft Conflict Advisory

Immediately issue an advisory to an aircraft under your control if you observe an aircraft that is not under your control at an altitude which, in your judgment, places both aircraft in unsafe proximity to each other. With the alert, offer the pilot an alternate course(s) of action when feasible.

EXAMPLE: VV15263. TRAFFIC ALERT, ADVISE YOU TURN RIGHT/LEFT HEADING (DEGREES) AND/OR CLIMB/DESCEND TO (ALTITUDE) IMMEDIATELY.

EXERCISE

13-40. How does Stage II radar service differ from Stage I?

13-41. How does Stage III radar service differ from the other stage services?

13-42. What items are included in the traffic information advisory?

13-43. Are additional services mandatory?

13-44. Which of the following is/are classified as additional radar service(s): separation of aircraft, providing approach information, vectoring aircraft to avoid target merging with unidentified targets, conducting surveillance radar approaches? Explain.

EMERGENCY ASSISTANCE

Learning Objective: **State the appropriate actions for assisting aircraft in given emergency situations.**

If you recall, we previously had a discussion of emergencies at the conclusion of Chapter 11. The items discussed at that time, such as emergency determination and necessity of obtaining enough information, are also applicable here. During the previous discussion, the slant was toward those types of emergencies which might normally be associated with control tower operations. This discussion is directed to those types of emergencies which might normally be encountered by approach control. However, since

potential emergencies defy complete standardization, there is no assurance that they will always occur in a specific control environment. The best advice we can present on emergencies is to expect the unexpected.

REQUIREMENTS AND TIMING

Start assistance as soon as enough information has been obtained upon which to act. Information requirements vary depending on the existing situation. Minimum required information for in-flight emergencies is:

1. Aircraft indentification and type.
2. Weather, as reported by the pilot.
3. Nature of the emergency.
4. Aircraft's altitude.
5. Pilot's desires.
6. Fuel remaining (in time).

After initiating action, some of the following items may be necessary in order to provide complete assistance. Obtain, as necessary, the following:

1. Pilot capability for IFR flight.
2. Time and place of last known position.
3. Heading since last known position.
4. Airspeed.
5. Point of departure and destination.
6. Navigation equipment capability.
7. NAVAID signals received.
8. Visible landmarks.
9. Aircraft color.
10. Number of people on board.
11. Emergency equipment on board.

As you can see from the second list, a number of items listed would be necessary data if you were trying to locate an aircraft whose pilot is unsure of his position; in other words—lost. It happens quite often, especially when inexperienced pilots encounter IFR weather. In this case, the major effort is to locate and identify the aircraft and then orient the pilot. The most recognized methods to do this are:

1. Radar.
2. Direction finder (DF).
3. NAVAIDs.
4. Pilotage by landmarks.
5. Sighting by and following another aircraft.
6. Compass headings.

RADAR ASSISTANCE TO VFR AIRCRAFT IN WEATHER DIFFICULTY

If a VFR aircraft requests radar assistance when it encounters or is about to encounter IFR weather conditions, first ask if the pilot is qualified for and capable of conducting IFR flight. If the pilot is qualified and capable, then request an IFR flight plan be filed and issue and coordinate the appropriate clearance. However, if the pilot is not qualified, or refuses to file an IFR flight plan, then take whichever of the following actions you deem appropriate:

1. Inform the pilot of airports where VFR conditions are reported. Then ask the pilot to conduct a VFR flight to such an airport.

2. If the action in item (1) is not feasible or the pilot declines to conduct VFR flight, provide radar assistance if the pilot:

- Declares an emergency.

- Refuses to declare an emergency and you have determined the exact nature of the radar services the pilot desires.

3. If the aircraft has already encountered IFR conditions, inform the pilot of the minimum safe altitude. If the aircraft is below the minimum safe altitude and sufficiently accurate position information has been received or radar identification is established, furnish a heading or radial on which the pilot can climb the aircraft in order to reach the minimum safe altitude.

Use the following techniques to the extent possible when you provide radar assistance to a pilot not qualified to fly in IFR conditions:

1. Avoid radio frequency changes, except as necessary to provide a clear communications channel.

2. Require the pilot to make turns while the aircraft is in VFR conditions so that the aircraft will be in straight and level flight while in IFR conditions.

3. Have the pilot lower the aircraft's landing gear and slow the aircraft to approach speed while in VFR conditions.

4. Avoid requiring the pilot to climb or descend the aircraft while in a turn in IFR conditions.

5. Avoid requiring any abrupt maneuvers.

6. Vector the aircraft to VFR conditions.

HIJACKED AIRCRAFT

Military facilities are required to notify the appropriate FAA ARTCC, or the host nation agency responsible for en route control, of any indication that an aircraft is being hijacked. Also provide full cooperation in the control of such an aircraft. Radar beacon code 7500 mode 3/A has been selected as the code for a pilot to transmit when the aircraft is being unlawfully interfered with. Therefore, pilots will refuse assignment of this code in any other situation.

When you observe a Mode 3/A, Code 7500 radar beacon reply, do the following:

1. Acknowledge and confirm receipt of the code by asking the pilot to verify it.

Example: (Aircraft call sign) (name of facility) VERIFY SQUAWKING SEVEN FIVE ZERO ZERO.

If the aircraft is not being unlawfully interfered with, then the pilot should inform you of such. However, if no reply is received or a reply is to the affirmative, then make no other requests but be responsive to requests from the aircraft.

2. Notify supervisory personnel.

3. Flight follow the aircraft and make normal handoffs without requiring transmissions or responses by the pilot unless communications have been established, in which case follow routine procedures.

4. If escort aircraft are dispatched, provide all possible assistance to the escort aircraft in placing them in a position behind the hijacked aircraft.

To the extent possible, give these same control services to VFR aircraft observed displaying the hijacked code.

COMMUNICATIONS FAILURE

Another type of emergency which frequently occurs is two-way radio failure. As you know, two-way radio communication is of primary importance in the control of IFR traffic. Loss of two-way communication with an aircraft complicates the job of controlling traffic. However, if you and the pilot of the aircraft concerned know the procedures outlined under emergency procedures for two-way radio failure, there is little danger when either of these situations arises.

Remember that the loss of two-way radio communication does not necessarily mean that the aircraft's receivers are not working. Quite frequently during two-way radio failure, the aircraft's receivers are operating normally and the pilot is able is receive instructions. With this in mind, you can sometimes issue an appropriate clearance in-the-blind. That is to say, you have no way of knowing whether the pilot receives your new clearance or not. When you choose this course of action, you must ensure that the aircraft is provided adequate separation from other traffic according to both the original clearance issued to the pilot prior to loss of communication and according to the latter clearance which was issued in-the-blind. The agency having control jurisdiction over the aircraft at the time communication is lost will normally be the agency that authorizes or makes such a transmission. Clearances broadcast in-the-blind are made through all available means of communication, including the voice features of NAVAIDs. If officials responsible for the aircraft approve, the center may request a clearance to be broadcast to the pilot to proceed at the minimum en route altitude to the alternate airport specified in the flight plan. This procedure is used in cases where the destination airport is below minimums or closed because of other conditions.

If your facility is radar equipped, attempt to reestablish communications by having the aircraft use its transponder or make turns to acknowledge clearances or to answer specific questions. By observing transponder and target returns on your

radar indicator, you can determine whether or not the aircraft is receiving your instructions. Sometimes, the pilot will attempt to advise radar facilities of the type of radio difficulty he is experiencing. Should the pilot of an aircraft equipped with a coded radar beacon transponder experience a loss of two-way radio capability he can be expected to: (1) Adjust the transponder to reply on Mode 3/A code 7700 (emergency) for a period of 1 minute. (2) Change to Code 7600 and remain on 7600 for a period of 15 minutes or the remainder of the flight, whichever occurs first. (3) Repeat steps 1 and 2, as practical. In the event the aircraft has both transmitter and receiver failure, you may be able to vector an intercept aircraft to the emergency aircraft. The intercepting aircraft can then lead the emergency aircraft to a suitable airport for landing. Phraseology that you should use in attempting to reestablish communication with an aircraft when your facility is radar equipped is as follows: REPLY NOT RECEIVED; IF YOU HEAR ME (appropriate instruction). If the pilot then follows your instructions, use the following phraseology; (action) OBSERVED; WILL CONTINUE RADAR CONTROL.

EXERCISE

13-45. If the pilot of a VFR aircraft contacts you and states that he is lost and in IFR weather, what should you do first?

13-46. If the pilot of a VFR aircraft which is about to encounter IFR conditions requests radar assistance, what should you do first?

13-47. Briefly describe what actions would be generally appropriate if the pilot of a VFR aircraft is about to encounter IFR weather, there are no airports in your immediate area having VFR conditions, and the pilot declares an emergency because he is not IFR qualified.

13-48. What radar beacon reply code has been solely designed as the hijack code?

13-49. Assume that you are vectoring an aircraft and you observe the beacon reply change from your terminal discrete code to the hijack code. What action should you take?

13-50. What are the anticipated pilot actions in the event of loss of two-way radio capability?

13-51. If you observe an aircraft on radar displaying a Mode 3, Code 7600, radar beacon reply, what does this tell you about the aircraft?

13-52. Assume that you are vectoring an aircraft, and you issue some instruction to the pilot and he does not reply. What action would you take?

CHAPTER 14

CARRIER AIR TRAFFIC CONTROL PROCEDURES

Learning Objective: **Recognize the responsibilities and general operating procedures of the Carrier Air Traffic Control Center (CATCC) during carrier operations and be able to differentiate between CV and LHA/LPH procedures.**

CV flight operations are necessarily different from those applicable ashore. The basic necessity for safe and efficient procedures may be even more prevalent aboard carriers. The conditions which affect CV flight operations are of a different nature since the carrier is a mobile airfield normally operating in areas where obstruction clearance presents little, if any, problem. This chapter is limited to a brief picture of the Carrier Air Traffic Control Center (CATCC). The CV and LHA/LPH NATOPS Manuals should be referred to for more details and to ensure the currency of information contained within this chapter.

CARRIER AIR TRAFFIC CONTROL CENTER

As defined by naval regulations, the operations officer of an aircraft carrier is responsible for the control of airborne aircraft operating from the carrier except those assigned to other authority. The primary facility through which the operations officer exercises this authority is the Carrier Air Traffic Control Center (CATCC). The air operations officer is responsible to the operations officer for all matters pertaining to flight operations and for the proper functioning of the CATCC. The CATCC is responsible for the status keeping of all carrier air operations and the control of all airborne aircraft, except as follows:

1. The air officer is responsible for visual control of aircraft operating in the carrier control zone. He is the clearing authority for the carrier control zone.

2. The landing signal officer (LSO) is responsible for the visual control of arriving aircraft immediately prior to landing.

3. The combat information center (CIC) officer is responsible for the mission control of the aircraft assigned to him.

Before proceeding with the responsibilities and procedures used to control air traffic on carriers, let's look at some of the terms you must be familiar with.

NOTE: Unless otherwise specified, "miles" means nautical miles.

DEFINITIONS OF CATCC TERMS

advisory control. A form of air control in which the controlling agency monitors radar and radio contact with the aircraft under its control and provides traffic advisories. Traffic separation is the responsibility of the individual pilot, with the assistance provided by the control agency.

air operations. That section of the operations department that is responsible for coordinating all matters pertaining to air operations, including the proper functioning of the CATCC.

angels. Altitude, in thousands of feet.

approach control. A control station in CATCC that is responsible for controlling air traffic from marshal until handoff to Pri-Fly or the final controller, and is also responsible for providing close control for all CCA bolter/waveoff traffic until a radar handoff to another control station has been accomplished.

automatic carrier landing system (ACLS)—

ACLS window. An area in space (normally 3.5 to 5 miles from touchdown point) in which an aircraft is acquired by radar for ACLS control.

command control. Acknowledgment that the aircraft is being controlled by data link signals.

coupled. Aircraft automatic flight control system that is engaged and linked to data link commands.

data link address. Discrete identification that is assigned to data link-equipped aircraft.

data link equipment. Automatic transmission device that is capable of a very high data rate.

data link monitor (DLM). For use in visually observing data being sent to an aircraft under ACLS control.

lockon. A verbal report from the final controller when SPN-42 radar acquires the aircraft and commences tracking. Mode I/II-equipped aircraft should receive ACL ready/lockon discrete light.

Mode I approach. Fully automatic approach to touchdown.

Mode IA approach. Automatic to 200 feet; 1/2-mile minimums with manual takeover to touchdown.

Mode II approach. Manual approach using ILS (crossed needles) instrument presentation.

Mode III Approach. CCA PAR talkdown approach; no special aircraft configuration required.

Mode 2T approach. Manual approach using needles instrument presentation as well as Mode III information.

needles. Acknowledgment that ILS needles in the aircraft are responding to data link signals.

ten-second discrete light. Illuminates approximately 10 seconds prior to touchdown, indicating that deck motion compensation (DMC) is being transmitted from Mode I-certified ships. Illuminates approximately 10 seconds prior to reaching minimums on ships that are certified only for Mode IA/II.

uncoupling. Aircraft being disengaged from the data link commands.

universal test message (UTM). Used to ensure proper operation of the shipboard data link equipment.

ball. A pilot report indicating that the visual landing aid is in sight.

base recovery course (BRC). The ship's magnetic heading during flight operations.

bingo. An order to proceed to and land at the field specified, using a bingo profile. Aircraft is considered to be in an emergency/fuel critical situation.

carrier air traffic control center (CATCC). The centralized agency responsible for the status keeping of all carrier air operations and the control of all airborne aircraft under the operations officer's cognizance, except those being controlled by CIC.

carrier control area. A circular airspace with a radius of 50 miles around the ship, which extends upward from the surface to unlimited altitude and is under the cognizance of CATCC.

carrier control zone. The airspace within a circular limit defined by a five-mile horizontal radius from the carrier, extending upward from the surface to and including 2,500 feet unless otherwise designated for special operations, and is under the cognizance of the air officer during VFR conditions.

CCA. Carrier controlled approach.

CCTV. Closed circuit television.

center. A collective radio call prefixed by a ship's code name which is used in the same manner as the shore based counterpart.

CHARLIE. Signal for aircraft to land aboard the ship. A number suffix indicates time delay before landing.

cherubs. Altitude, in hundreds of feet (applies only to helicopters).

clara. A pilot transmission meaning he does not have the visual landing aid (ball) in sight.

close control. A form of air traffic control in which the controlling agency has radar and radio contact with the aircraft being controlled and published approach or departure procedures are complied with, or where specific assignments regarding heading and altitude are issued by the controller. While altitude separation is provided by pilots maintaining assigned altitude, lateral and time separation is the responsibility of the air controller. Speed changes may be directed by the air controller.

COMSEC. Communication security.

CQ. Carrier qualifications.

DELTA. A signal given to hold and conserve fuel at an altitude and position appropriate to the type aircraft and case recovery in effect.

departure control. A control station in CATCC that is responsible for the orderly flow of assigned departing traffic.

divert. An order for an aircraft to proceed to and land at the field specified. This is a nonemergency situation.

EMCON. Electronic emission control.

emergency expected approach time (EEAT). The future time, assigned prior to launch, at which an aircraft is cleared to depart inbound or penetrate from a preassigned fix under lost communication conditions.

emergency marshal. A marshal established by CATCC and given to each pilot prior to launch, with an altitude and an EEAT. The emergency marshal radial shall have a minimum of 30° separation from the primary marshal.

expected approach time (EAT). The future time at which an aircraft is cleared to depart inbound or penetrate from a preassigned fix. Aircraft departs and commences approach at the assigned time if no further instructions are received.

final bearing (FB). The magnetic bearing assigned by CATCC for final approach. It is an extension of the landing area centerline.

final control. A control station in CATCC responsible for controlling traffic in instrument conditions from acquisition until the pilot reports "Ball" or reaches approach minimums.

flight level. Pressure altitude expressed in hundreds of feet, determined by setting 29.92 in the aircraft pressure altimeter; that is, FL230 equals 23,000 feet pressure altitude.

helicopter airspace. That airspace extending from the surface to 400 feet between 030° and 135° relative to the ship and extending out to five miles.

HERO. Hazards of electromagnetic radiation to ordnance.

IMC. Instrument meteorological conditions.

inbound bearing. The magnetic heading assigned by CATCC to pilots descending directly to the carrier. It may be, but is not necessarily, the final bearing.

inbound heading. The magnetic heading assigned by CATCC that will ensure interception of the final bearing at a specific distance from the carrier.

KILO report. A pilot coded report indicating aircraft mission readiness.

LSO. Landing signal officer.

marshal. A bearing, distance, and altitude fix designated by CATCC, from which the pilots will orient holding and from which the initial approach will commence.

marshal control. A control station in CATCC that is responsible for the orderly flow of inbound traffic.

monitor control. The monitoring of radar and radio channels for emergency transmissions.

MOVLAS. Manually operated visual landing aid system.

nonprecision approach. Radar controlled approach or an approach flown by reference to navigation aids in which the glide slope information is not available.

nonradar control. A form of air traffic control in which the pilot flies according to a published procedure or as prescribed by the controlling agency. Traffic separation is provided by the controlling agency, using frequent pilot position reports and modified separation criteria. This form of control is used only in case of emergency, when all shipboard air control radar is inoperative or, in the opinion of the CATCC officer, unusable.

parrot. Military IFF/transponder.

PIM. Position of intended movement.

pigeons. Magnetic bearing and distance from an aircraft to a specific location.

PLAT. Pilot landing aid television.

platform. A point at 5,000 feet altitude in the approach pattern at which all jet and turboprop aircraft will decrease their rate of descent to not more than 2,000 feet per minute, continuing letdown to the ten nautical miles DME fix.

popeye. A pilot's term used to indicate that his aircraft has entered IMC.

port holding pattern. The Case I jet and turboprop aircraft holding pattern is a left-hand, five mile pattern tangent to the BRC or expected BRC, with the ship in the 3 o'clock position of the holding pattern. The altitude is assigned via landing order as established in the ship/air wing doctrine.

precision approach. An approach in which the azimuth and glide slope information are provided to the pilot.

Pri-Fly. Primary flight. The position on the ship where the air officer or his designated representative observes flight deck operations and provides VFR control to aircraft operating in the carrier control zone.

ramp time (ready deck). Anticipated time specified by Pri-Fly that the deck will be ready to recover aircraft and the first aircraft of a Case III recovery is expected to be at the ramp.

six nautical mile DME fix. A check point in a CCA, located on the final bearing six miles from the carrier, through which all jet and turboprop aircraft will pass in level flight at an altitude of 1,200 feet in landing configuration. Propeller aircraft will pass through the six nautical mile DME fix at 1,200 feet and 140 knots and normally commence transition to the landing configuration.

spin. A signal given to one or more aircraft indicating a departure from and reentry into the break. The command "Spin" may be issued by either the air officer or a flight leader.

starboard holding pattern. A right-hand racetrack pattern between 045° and 135° relative to the ship for prop aircraft and 045° and 110° relative for helicopters. Prop aircraft, 500 feet; helicopters, 300 feet or below.

ten nautical mile DME fix. A check point in a CCA, normally located on the final bearing, 10 miles from the carrier. All jet and turboprop aircraft will pass through the ten nautical mile DME fix in level flight at an altitude of 1,200 feet, 250 KIAS, and will normally commence transition to the landing configuration.

three nautical mile DME fix. A check point in a CCA, on the final bearing three miles from the carrier, through which all propeller aircraft and helicopters will pass in a landing configuration.

VMC. Visual meteorological conditions.

V/STOL. Vertical/short takeoff and landing.

weather criteria. Case I weather requires that the ceiling be no lower than 3,000 feet and the visibility not less than five miles. Case II weather requires that the lowest ceiling be 1,000 feet or above and a five mile visibility. Case III weather is any ceiling below 1,000 feet or a visibility of less than five miles.

Zip-Lip. A condition that may be prescribed for flight operations during daylight VMC conditions, under which positive communications control is waived, and radio transmissions between aircraft and between pilots and control agencies are held to the minimum necessary for flight safety.

Since CATCC covers a wide area of responsibility, you must be properly indoctrinated in all phases of carrier air operations. Rotation of personnel in various operating positions is desirable, as personnel abilities and qualifications allow, to provide you with a better understanding of the aspects involved. Additionally, the rotation may impress upon you the value of the teamwork necessary within the CATCC.

Basically, CATCC can be broken down into two branches: Air Operations (Air Ops) and Carrier-Controlled Approach (CCA).

AIR OPERATIONS

The mission of Air Operations is to serve as a coordinating and scheduling center for the ship's flight operations and to furnish pertinent flight information to the pilots.

The positions in Air Operations are as follows:

1. Air Operations Officer.
2. Assistant Air Operations Officer.
3. Air Operations Supervisor.
4. Section Leader.
5. Radio Operator—Ship/Shore Communications.
6. Land/Launch Recordkeeper.
7. Status Board Keeper.
8. Teletype Operator.
9. Dead Reckoning Tracer (DRT) Operator.
10. Sound-Powered Telephone Talker.

The duties and responsibilities of the Air Operations personnel assigned to the operating positions below the section leader level are discussed here.

Radio Operator

The radio operator establishes and maintains radio communications with the shore activities on Raspberry, Air Defense Liaison, and intratype frequencies, as applicable. He ensures that the Air Ops officer sees all messages received. He also is responsible for the following:

1. Maintains a routine message log and the message boards for the CATCC.
2. Makes sure that all messages are initialed and filed.

Land/Launch Recordkeeper

The person in this position mans the 2JG sound-powered aircraft information circuit and uses it to relay information to the pilots' readyrooms as a followup to the interior teletype. He also:

1. Maintains the ship's aircraft launch and landing log.
2. Ensures the accuracy of the aircraft calls, side numbers, and pilots' names on the status boards.

Status Board Keeper

The status board keeper uses a split headset to man both the 2JG circuit and the land/launch frequencies and records pertinent information on the status board. This includes the fuel state of each aircraft.

Teletype Operator

This operator is in charge of the teletype transmitter for the CATCC. The duties include the handling of shore-to-ship and ship-to-shore flight plans and flight information messages. Receiver repeaters are located in pilots' readyrooms to pass information to pilots, such as changes in the flight schedule, weather, ship's intended movement, etc.

DRT Operator

The operator of the Dead Reckoning Tracer:

1. Knows the location of maps, charts, and publications used in the CATCC.
2. Provides bearing and distances of the nearest land and airfields to CCA, CIC, Pri-Fly, and the status board keeper every half hour, and at other intervals as specified by the Air Operations Officer.
3. Properly operates the DRT and periodically checks the ship's indicated position with the ship's navigator.
4. Makes sure the navigation information on the status board is accurate.
5. Keeps up-to-date information on the danger areas, operating areas, firing areas, etc., on the chart in use.
6. Obtains the position of intended movement (PIM) information from the navigation personnel and checks its relation to flight advisory areas and other control areas.

CCA

The contraction CCA as used in this instance is expanded to include all those operating positions involved in the actual radar control of the airborne aircraft under the operations officer's cognizance, except those being controlled by the combat information center (CIC).

In many instances some of these positions may be combined due to personnel shortages. However, an ideal arrangement is as follows:

1. One CCA Officer.
2. One Assistant CCA Officer.
3. One CCA Supervisor (normally a CPO).
4. One Departure Controller.
5. One Departure Status Board Keeper.
6. One Marshal Controller.
7. One Marshal Status Board Keeper.
8. Two Approach Controllers.
9. Two Final Controllers.
10. One Approach Status Board Keeper.
11. Two Sound-Powered Telephone Talkers.

The duties and responsibilities of some personnel below the supervisor level and assigned to CCA are discussed in the following paragraphs.

Departure Controller

Primary responsibility for adherence to the assigned departure rests with the pilot; however, advisory control is normally exercised, with a shift to close control as required by weather conditions, upon request, or when the assigned departure is not being adhered to. In addition, the departure controller is responsible for the following:

1. Ensuring that communications and positive track are established with all aircraft, to the extent possible under existing electronic emission control (EMCON) conditions.
2. Requesting NAVAID checks as necessary.
3. Maintaining advisory control of departing point-to-point flights until pilots shift to en route frequencies, and of other aircraft until control is accepted by the CIC or another controlling agency.
4. Before releasing the aircraft to another controlling agency, giving each pilot (flight leader) any pertinent information such as changes in composition of the flight, changes in the PIM, or in the mission.
5. When transferring control to the CIC, giving them the range and bearing of the aircraft being transferred, and ensuring that they acknowledge assumption of control.
6. Effecting the rendezvous of the tanker/tankee aircraft during refueling operations.

Departure Status Board Keeper

The departure status board keeper maintains the appropriate status board for the departure controller.

Marshal Controller

Upon entering the carrier control area, inbound flights are normally turned over to the marshal controller for further clearance to the marshal pattern. The marshal controller must provide the inbound flight with the following:

1. Marshal instructions.
2. Steer to marshal (if required).
3. Type of recovery.
4. Ramp time.
5. Altimeter setting and weather.
6. Expected final bearing.

The marshal controller must also ensure that the following information has been provided to each aircraft prior to commencing approach:

1. Expected approach time.
2. Final control frequency.
3. Type of approach.
4. Final bearing.
5. Time check.
6. Other pertinent data such as the changes in weather conditions, altimeter setting, etc.

To reduce frequency congestion, items of general interest may be transmitted as a "99" broadcast (to blocks of aircraft) rather than making repetitious broadcasts to individual aircraft.

Approach Controller

The approach controller assumes control of the inbound aircraft from the marshal controller. Circuit discipline is essential because two controllers and several aircraft are on each frequency. Two approach controllers are normally used, each on a separate frequency and with a final controller being on the same frequency. Each controller normally controls every other aircraft and passes control of each aircraft to the final controller when the aircraft reaches approximately 6 miles inbound (4 miles when using SPN-42). This procedure will vary when the radar equipment used provides a complete PAR approach; i.e., glidepath as well as azimuth, such as the SPN-42. This equipment is discussed later in this chapter.

In addition, the approach controller is responsible for the following:

1. Monitoring the aircraft's letdown and providing assistance on TACAN approaches.
2. Providing positive radar control during periods of TACAN failure.
3. Maintaining the proper interval between aircraft on all approaches.
4. Controlling the fouled deck holding pattern to maintain proper separation.
5. Ensuring that approach control information on the approach status board is current and correct.

Final Controller

The final controller assumes positive control as soon as radar contact is established, normally at 6 miles from the ramp (4 miles on SPN-42). There are normally two final controllers, each of whom is on a frequency with an approach controller.

Approach Status Board Keeper

The approach status board keeper monitors the approach and final frequencies, using a split headset, and ensures that the latest information is displayed on the approach status board.

It is mandatory that personnel assigned duty as a status board keeper know that the CCA officer and supervisor rely on the information displayed on the status boards in order to maintain the teamwork balance required to make successful efficient approaches. Each operator also relies on the status board for pertinent information required for this respective position. Current and correct status boards provide CCA supervisors a comprehensive display of the entire recovery, thereby eliminating interruption of the controlling personnel for progress reports.

Sound-Powered Telephone Talkers

The X1JG sound-powered telephone talker is assigned to provide direct communications to

Pri-Fly and the LSO. The 2JG sound-powered telephone talker is assigned to receive and transmit the general aircraft information to and from other offices concerned, such as CIC.

PRELAUNCH RESPONSIBILITY

To obtain the maximum efficiency from personnel and equipment, carrier air operations must be precisely scheduled. CATCC is the scheduling and coordinating agency for all flights. The air operations officer is responsible for collecting all the required information and preparing the daily air plan. He shall submit the daily air plan to the operations officer for approval and signature.

The air operations officer shall ensure that the accurate BINGO fuel and fouled deck endurance data are available for each model aircraft being deployed. He shall also ensure that the air control personnel are proficient in the interpretation of this data.

Preliminary Procedures

One and one-half hours before scheduled flight operations, CATCC shall be manned and the following checkoff list executed, commensurate with the EMCON Plan in effect:

1. Check all the radio equipment, CCA equipment, and NAVAIDs for proper operation and frequencies. Immediately report all the discrepancies for appropriate action and advise the air operations officer who advises the commanding officer if equipment failures will affect the air operations.
2. Establish radio communications with the shore activities on Raspberry and teletype frequencies as applicable.
3. Test intercom, sound-powered, and teletype circuits.
4. Obtain the weather for the operating area and shore stations within the aircraft range. Advise meteorology of any special requirements for weather information during the day.
5. Update the aircraft status board. Advise the operations officer, the bridge, and the flag plot if aircraft availability will seriously limit scheduled air operations.
6. Obtain the PIM and check its relation to the flight advisory areas and other control areas.
7. Check the message traffic for information which might affect the day's operations.
8. Check the air plan for changes and notify stations concerned.
9. Check the clocks for proper time.
10. Check the pitlog and wind repeaters for proper operation.
11. Check all the status boards for completeness and accuracy of information.
12. Ensure that the squadron flight schedules have been received.

When Flight Quarters is sounded, CATCC shall:

1. Check the manned readyrooms and ensure that the teletypes/television are operational.
2. Send the prelaunch information.

CATCC BRIEF.—To ensure that the flight crews have sufficient information to complete the assigned mission, CATCC provides the following briefing information:

1. Launch and recovery times.
2. PIM.
3. NAVAIDs status and frequencies.
4. Ship's weather.
5. Weather at BINGO fields and en route.
6. Emergency data, which includes the following:
   a. Bearing and distance to the nearest land.
   b. Bearing and distance to the nearest suitable landing field.
   c. NAVAIDs, frequencies, and facilities at the nearest landing field.
   d. Ready carrier calls, frequencies, NAVAIDs, and PIM.
   e. Expected final bearing.
   f. Emergency marshal fixes/altitudes/approach times.
7. Air traffic control data, which includes the following:
   a. Departure/rendezvous radials.
   b. Departure frequency and IFF/SIF mode and code.
   c. Special procedures for Zip-Lip/EMCON conditions (if in effect).
8. Any restrictions or hazards to flight.
9. Pertinent information not in the air plan.

CATCC must also provide this information to the aircraft not embarked on the ship but engaged in support operations, such as carrier onboard delivery (COD) and vertical onboard delivery (VOD) aircraft.

The CATCC brief is normally passed to the readyrooms via the ship's closed circuit television (CCTV).

FLIGHT PLANS.—The requirements for filing flight plans and advisories vary with each operating area and are contained in the Flight Planning Document and in Fleet Operating Directives. As a rule, flight plans are required for flights which:

1. Terminate ashore.
2. Proceed across ADIZ boundaries and are not covered by a flight advisory.
3. Proceed over land.

Flight advisories shall be filed for flights within the ADIZ boundaries by all aircraft which will land back on board ship and are not covered by a flight plan. Upon receipt of the daily air plan, squadrons shall prepare the necessary flight plans (DD Form 175/ICAO) and file them with CATCC as far in advance of the scheduled launch time as possible.

In addition, OPNAVINST 3710.7 (Series) stipulates the following:

1. Prior to flight from a shore activity to a ship operating in offshore areas when a landing aboard the ship is intended, the pilot in command shall file a flight plan. For flights conducted under instrument flight conditions, a DD Form 175 shall be filed. Flights conducted under visual flight rules may use an abbreviated DD Form 175 or daily flight schedule.

2. Flight plans must be filed when flights originating from offshore operating areas will penetrate the controlled airspace or terminate at shore activities. Ships shall relay flight plans to the appropriate ATC facilities in a timely manner, and pilots shall confirm their flight plans with an appropriate ATC facility ashore as soon as practicable.

3. Timely handling of the flight movement information for each shore/ship operation is essential.

4. Flight suspense for the search and rescue purposes becomes the responsibility of the destination activity after acknowledging the receipt of a flight plan.

5. Procedures for flights penetrating or operating within a coastal or domestic Air Defense Identification Zone (ADIZ) or Defense Early Warning Identification Zone (DEWIZ). The Air Defense Identification Zones are prescribed in the FLIP (Enroute) IFR Supplement.

NOTE: Aircraft carrier type training which may include cyclic operations, ALFA strikes, and the launch sequence plans shall be coordinated in advance with the ARTCCs involved with providing IFR service to the carrier's aircraft. Specific time requirements for advance notification should be covered in Letters of Agreement between the ARTCC and the local Navy command.

Procedures for the coordination and handling of the air wing flyoffs from aircraft carriers returning from overseas deployment shall be developed between appropriate east- or west-coast ARTCCs and the appropriate Navy commands.

EXERCISE

In items 14-1 through 14-4, select from Column B the responsibility of the officer or agency listed in column A.

COLUMN A	COLUMN B
14-1. Operations Officer	A. Responsible for the visual control of arriving aircraft immediately prior to landing.
14-2. Air Officer	B. Responsible for the visual control of aircraft within the carrier control zone.
14-3. LSO	C. Responsible for the status keeping of all carrier aircraft and the control of aircraft not in the control of the air officer, CIC, or LSO.
14-4. CATCC	D. Responsible for the control of aircraft operating from a carrier except those assigned to other authority.
	E. Responsible for the mission control of aircraft.

In items 14-5 through 14-7, select from Column B the CATCC term identified by each definition listed in Column A.

COLUMN A	COLUMN B
14-5. An order to an aircraft to proceed immediately to a divert field.	A. CCA
	B. BINGO
14-6. Aircraft automatic flight control system engaged and linked to data link control.	C. Inbound bearing
	D. COUPLED
14-7. Carrier Controlled Approach	

14-8. What two ATC branches make up a CATCC?

14-9. The mission of ________ is to serve as a coordinating and scheduling center for the ship's flight operations and to furnish pertinent flight information to the pilots.

14-10. The Land/Launch recordkeeper is a position within what branch of CATCC?

14-11. Which operating position within Air Ops is responsible for the handling of ship-to-shore and other flight information messages?

14-12. Which position within Air Ops keeps up to date information on the danger, operating, and firing areas, etc.?

14-13. What branch of CATCC is responsible for the radar control of aircraft not under the control of CIC?

14-14. During a CCA recovery, which two controllers normally share the same frequency?

14-15. Normally, which controller position within CCA affects the rendezvous of the tanker/tankee aircraft during refueling operations?

14-16. When the marshal controller desires to broadcast items of general interest, the broadcast must be preceeded by what phrase?

14-17. To ensure that the preliminary checkoff list is completed, CATCC shall be manned how long before scheduled flight operations?

14-18. If the ship is so equipped, how will CATCC briefs be passed to the readyrooms?

14-19. As a rule, flight plans are required for which types of flights operating from a ship?

CONTROL CRITERIA

Existing weather in the ship's control area and control zone is the most prominent factor affecting the degree of control necessary. The type of control to be used during the departure and recovery operations is determined by the air operations officer unless specified by a higher authority. In periods of reduced ceiling and/or visibility, electronic air traffic control techniques must be used to provide separation and maximum safety.

The degree of control exercised by CATCC is described as close control, advisory control, or monitor control.

Close control is defined as a form of air traffic control in which the controlling agency has radar and radio contact with the aircraft being controlled, and the published approach or departure procedures are being complied with or the specific assignments regarding heading and altitude are being issued by the controller. Vertical separation is provided by requiring pilots to maintain assigned altitudes or flight levels, while lateral or longitudinal separation is provided by the controller. Speed changes may be directed by the controller.

Close control is used when the following conditions exist:

1. Ceilings of less than 1,000 feet for fixed-wing operations and less than 500 feet for helicopters.
2. Flight visibility of 3 miles or less for fixed-wing operations or 1 mile or less for helicopters.
3. Whenever flight operations are conducted between one-half hour after sunset and one-half hour before sunrise, except as modified by the Officer in Tactical Command (OTC) or the commanding officer.
4. During mandatory letdown in thunderstorm areas.
5. In any other situation where supervisory personnel can anticipate weather phenomena that might cause difficulty to pilots.

Advisory control is a form of air traffic control in that the controlling agency maintains radio and radar contact with aircraft under its cognizance and provides traffic advisories. Traffic separation is the responsibility of the pilot making use of the assistance provided by the agency. Advisory control must be used when the traffic density in a operating area requires a higher degree of control for the safety of flight than is provided by the see-and-be-seen method. Advisory control is normally limited to VMC (Visual Meteorological Conditions) weather conditions and is recommended for all operations in or adjacent to the oceanic control areas or routes.

Monitor control is the monitoring of the radar and radio channels for emergency transmissions. Monitor control must be used only when aircraft are operating in the VMC, outside of controlled airspace, and the responsibility for separation from other traffic can be safely assumed by the pilot.

SEPARATION CRITERIA

The following separation standards are used by the Carrier Air Traffic Controllers for aircraft under close control. These restrictions do not apply to tactical maneuvers such as air intercept, rendezvous, and close ASW (anti-submarine warfare) action.

Lateral Separation

1. When using designated air search radars (ASR) that rotate in excess of 7 rpm, provide the following separation standards:

   a. Aircraft operating at 50 miles or more from the monitoring antenna by a minimum of 5 miles.

   b. Aircraft operating less than 50 miles from the monitoring antenna by a minimum of 3 miles.

   c. Aircraft operating on an approved designated approach and inside of 10 miles by a minimum of 2 miles.

   d. Aircraft under nonradar control using a published approach by a minimum of 2 minutes or 5 miles DME.

2. When providing close control of aircraft with all other radars, separate them by a minimum of 5 miles.

Vertical Separation

1. Separate jet and turbopropeller (turboprop) aircraft operating at altitudes up to and including FL 290 by 1,000 feet. Five hundred feet separation may be permitted for propeller-driven aircraft when required.
2. You may reduce vertical separation to 800 feet when inside of 10 miles.
3. Separate aircraft operating at altitudes above FL 290 by 2,000 feet.

NOTE: Carrier-based aircraft must fly flight levels at and above 18,000 feet MSL unless the regional air control procedures dictate otherwise.

4. Separate helicopters by 500 feet.

DEPARTURE CONTROL

Departure procedures are based upon the assignment of TACAN radials for the purpose of providing lateral separation. The minimum standard separation of departure radials is 20°.

You would normally assign departure radials dependent on the following:

1. Mission of the aircraft.
2. Number of carriers in the formation.
3. Topographical features in the area.
4. Those radials reserved for emergencies, letdowns, or propeller aircraft and helicopter holding.

Direct routing should be used as much as possible in order to lessen delay time in the execution of departures.

Position reports that pilots are required to make to departure control vary depending upon the weather, state of training, EMCON, and type of operation being conducted. The following pilot reports are considered minimum during IMC (Instrument Meteorological Conditions) and night operations:

1. Airborne.
2. Passing 2500 feet.
3. Arcing.
4. Established outbound (on assigned radial).
5. Popeye, with altitude.
6. On top, with altitude.
7. KILO (mandatory).

NOTE: When in IMC, a Popeye report is mandatory for single aircraft upon reaching the assigned departure altitude, or at FL180 for jets and turboprops and 7000 feet for props. This report alerts the departure controller that further instructions are required.

The degree of control you will exercise by CATCC for departures depends upon the existing weather conditions. The weather criteria for departures are as follows:

1. Case I. Appropriate when it is anticipated that flights will not encounter instrument conditions during departures and rendezvous, with weather conditions no lower than 3,000 feet and a 5-mile visibility.

2. Case II. Appropriate when visual conditions at the ship exist down to a ceiling of 1,000 feet and a visibility of 5 miles.

3. Case III. Appropriate when weather conditions are below the minimums for Case II or during night operations.

EXERCISE

14-20. Unless specified by a higher authority, what officer determines the type of control to be used during departure and recovery operations?

14-21. What three degrees of control may be exercised by CATCC?

14-22. What degree of control is mandatory when letdown is necessary in thunderstorm areas?

14-23. What degree of control is referred to as the see-and-be-seen method?

14-24. When using designated air search radars which rotate in excess of 7 rpm, what is the minimum lateral separation between aircraft operating (a) less than 50 miles from the antenna, (b) 50 miles or more from the radar, and (c) inside of 10 miles and on an approved approach?

14-25. What is the minimum vertical separation that you may provide between jet aircraft when they are within 10 miles of the ship and below FL 290?

14-26. What is the minimum vertical separation between helicopters?

14-27. When departure procedures are based on the assignment of TACAN radials, what is the minimum standard separation of departure radials?

14-28. What is the weather criteria of Case I departures?

14-29. What is the weather criteria for Case II departures?

14-30. When exercising close control of departures, what case of departure control is used?

ARRIVAL CONTROL

Inbound flights entering the carrier control area (50-mile radius) are normally turned over to marshal control for further clearance to the marshal pattern. Positive radar identification should be accomplished by the receiving controller prior to the transfer of control. Control may be transferred only after the receiving controller has notified the transferring controller that positive radar contact exists. Transient helicopters approaching the carrier for landing must contact the center at least 25 miles out. Aircraft which were unable to check in with the strike, mission, or marshal control due to communications difficulties, should proceed inbound to the emergency marshal at the briefed holding altitude.

The flight leader should provide you, the marshal controller, with certain items of information which include:

1. Position.
2. Altitude.
3. Low fuel state in flight.
4. Total number of aircraft in flight (line up).
5. Type ACLS approach requested—if applicable, UTMs sweet or sour (being received or not).
6. Other pertinent information such as navigational aid status, hung or unexpended ordnance, weather, etc., which may affect recovery.

You should provide the flight with the following information:

1. Marshal instructions.
2. Steer to marshal (if required).
3. Type of recovery/approach.
4. Expected approach time (EAT).
5. Time check.
6. Expected final bearing.
7. Additional information such as divert field/fuel data, etc.

MARSHAL PROCEDURE

A common question asked by trainees is "Why the word MARSHAL?" This is a good question. Apparently reference is being made to one of the many meanings of the word, which is "to arrange objects or people in order." Compared to approach procedures ashore, a marshal fix would be the same as the initial approach fix.

A primary TACAN marshal fix is normally established on a predetermined radial at a distance appropriate for the type of aircraft; i.e., jet, prop, or helo. The radial is established with reference to the base recovery course (BRC). The BRC is the ship's magnetic heading for recovery of aircraft.

Jet/Turboprop Aircraft

For jet and turboprop aircraft, the primary TACAN marshal fix is normally on the 180° radial relative to the expected final bearing, at a distance of 21 miles plus 1 mile for every 1,000 feet of altitude. The base altitude will be as assigned but not lower than 6,000 feet in any case.

The holding pattern is a left-hand 6-minute racetrack pattern. The inbound leg shall pass over the holding fix.

Prop Aircraft

The primary TACAN marshal for prop aircraft is the 150° radial relative to the expected final bearing (FB), at a distance of 8 miles plus 1 mile for every 1,000 feet of altitude. Base altitude will be assigned but not lower than 2,000 feet in any case. The holding pattern is a right-hand 6-minute racetrack pattern. The inbound leg shall pass over the holding fix.

Helicopters

The primary TACAN marshal for helicopters is the 110° radial relative to the expected FB at a distance of 1 mile for every 500 feet of altitude, starting at 1,000 feet and 5 miles. The holding pattern is a right-hand 6-minute racetrack pattern. The inbound leg shall pass over the holding fix.

Emergency Marshal

Fixed-wing aircraft are issued an emergency marshal radial prior to launch in the event of radio failure. Normally the emergency marshal radial is 150° relative to the expected FB at a distance of 15 miles plus 1 mile for every 1,000 feet of altitude. Jet/turboprop aircraft shall not be assigned an altitude below 5,000 feet. The holding sequence is jets first; turboprops second. The holding pattern is a right-hand 6-minute racetrack pattern, with the inbound leg passing over the holding fix. The helicopter emergency marshal radial is the same as the normal helicopter marshal radial with emergency holding normally commencing at 7 miles.

Overhead Marshal

In the event of TACAN failure, geographical considerations, or operational circumstances, the overhead marshal may be used. The assigned inbound magnetic bearing to the holding fix should coincide with the outbound magnetic bearing/radial of the approach. Emergency expected approach times (EEATs) from the overhead marshal should be every other minute.

En Route Radar Approach

In the event an aircraft or flight cannot reach the assigned marshal point in time to make an assigned approach time due to mission, fuel state, or ordnance load, you may use an en route radar approach to place the flight in the proper approach sequence. Positive radar control is required and you should provide the pilot a brief description of the intended penetration whenever possible.

Marshal Altitude Assignment/Separation

Every effort should be made to anticipate the weather conditions and provide marshaling in visual conditions if practical. Aircraft below an overcast cloud layer should not be required to climb into the overcast in order to comply with the marshal altitude limits, if the marshal controller can maintain the interval and sequence from the lower altitude. Aircraft above an overcast cloud layer should be assigned altitudes above the overcast and retained in formation where possible.

Limit formation flights to a maximum of four aircraft at any one assigned altitude. Under instrument conditions, a section of two aircraft is the maximum number authorized in any one flight and hence at the same marshal altitude.

Normally, you should assign fixed-wing aircraft marshal altitudes which provide a 1,000-foot vertical separation. Helicopters are assigned altitudes at marshal which provide a 500-foot vertical separation.

NOTE: When the flights of two aircraft are held at marshal during instrument conditions, it is advisable to provide vertical separation of 2,000 feet between flights. This procedure ensures that you can provide the required 1,000 feet of vertical separation in the event that a flight must be broken-up.

APPROACH CRITERIA

The air operations officer determines the type of approach and the required degree of control. The degree of control exercised by CATCC

depends upon the existing weather conditions. The weather criteria for approach are as follows:

1. Case I. Appropriate when it is anticipated that the flight will not encounter instrument conditions at any time during the descent, break, and final approach. A ceiling of 3,000 feet and visibility of 5 miles within the carrier control zone are required.

2. Case II. Appropriate when the weather conditions are such that the flight may encounter instrument conditions during the descent but visual conditions of at least a 1,000-foot ceiling and a 5-mile visibility exist at the ship.

3. Case III. Appropriate when the existing weather at the ship is below Case II minimums, and during all flight operations conducted between l/2-hour after sunset and l/2-hour before sunrise.

APPROACH MINIMUMS

The commanding officer establishes the approach minimums for his ship which reflect significant changes in operational capabilities, such as may be occasioned by decreased/increased proficiency of the CATCC or the embarked air wing/group. However, absolute minimums are established as follows:

1. PAR; ILS; ACLS Modes IA, II, and III—200:1/2.
2. ACLS Mode I—as certified.
3. Nonprecision:
   a. Jet—600:1 1/4
   b. Prop/turboprop—400:1.
   c. Helo—300:3/4.

When a suitable BINGO field is available, the aircraft may not commence an approach if the reported weather is below the minimums, as previously described, unless it has been determined that the aircraft has enough fuel to proceed to the BINGO field in the event of a missed approach.

APPROACH PROCEDURE

The approach procedures described and depicted in this section are primarily for single carrier operations. However, with slight modifications they can be used for multicarrier operations; letdown under reduced navigation and control, using a plane guard destroyer's NAVAID(s); and during EMCON conditions.

Figure 14-1 depicts the various symbols used on the approach charts.

Figures 14-2 and 14-3 are examples of the approaches designed for use on the carriers regardless of the weather conditions. Each ship should use the standard approaches contained in the CV NATOPS Manual so that pilots who transfer to other ships will find only minimum changes in the operating procedures.

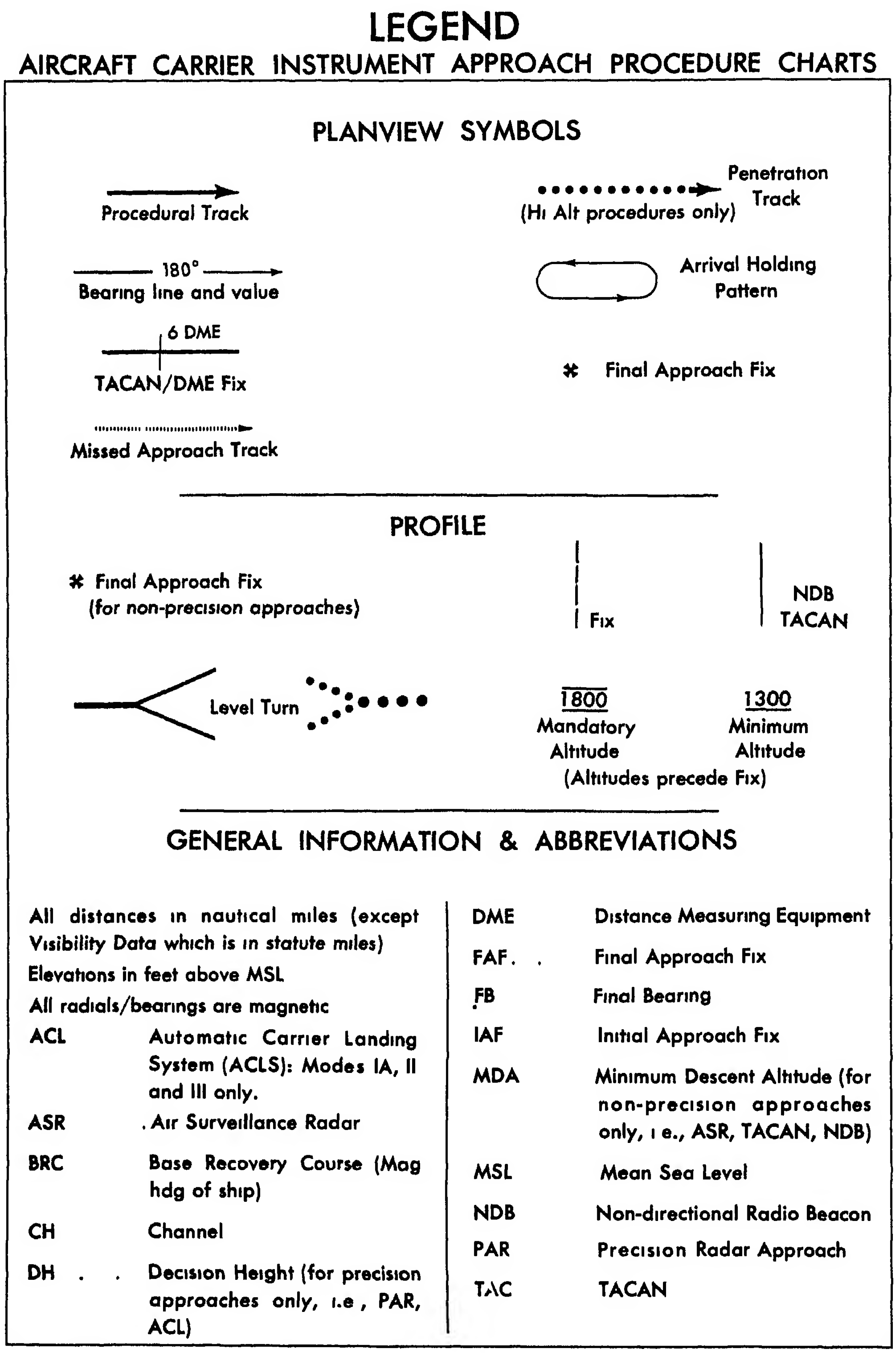
Case I Recovery

All returning flights must check in with marshal control when entering the control area, or as soon as they are released by another controlling agency. As marshal controller, you must acknowledge the check-in and advise all flights of any change in the ship's weather, type recovery, expected BRC, altimeter, or expected recovery time. The flight leader retains full responsibility for the proper navigation and separation from other aircraft. You would normally switch him to tower control after he reports the ship in sight and is within 10 miles. Case I recoveries shall not be conducted concurrently with Case III departures.

Case II Recovery

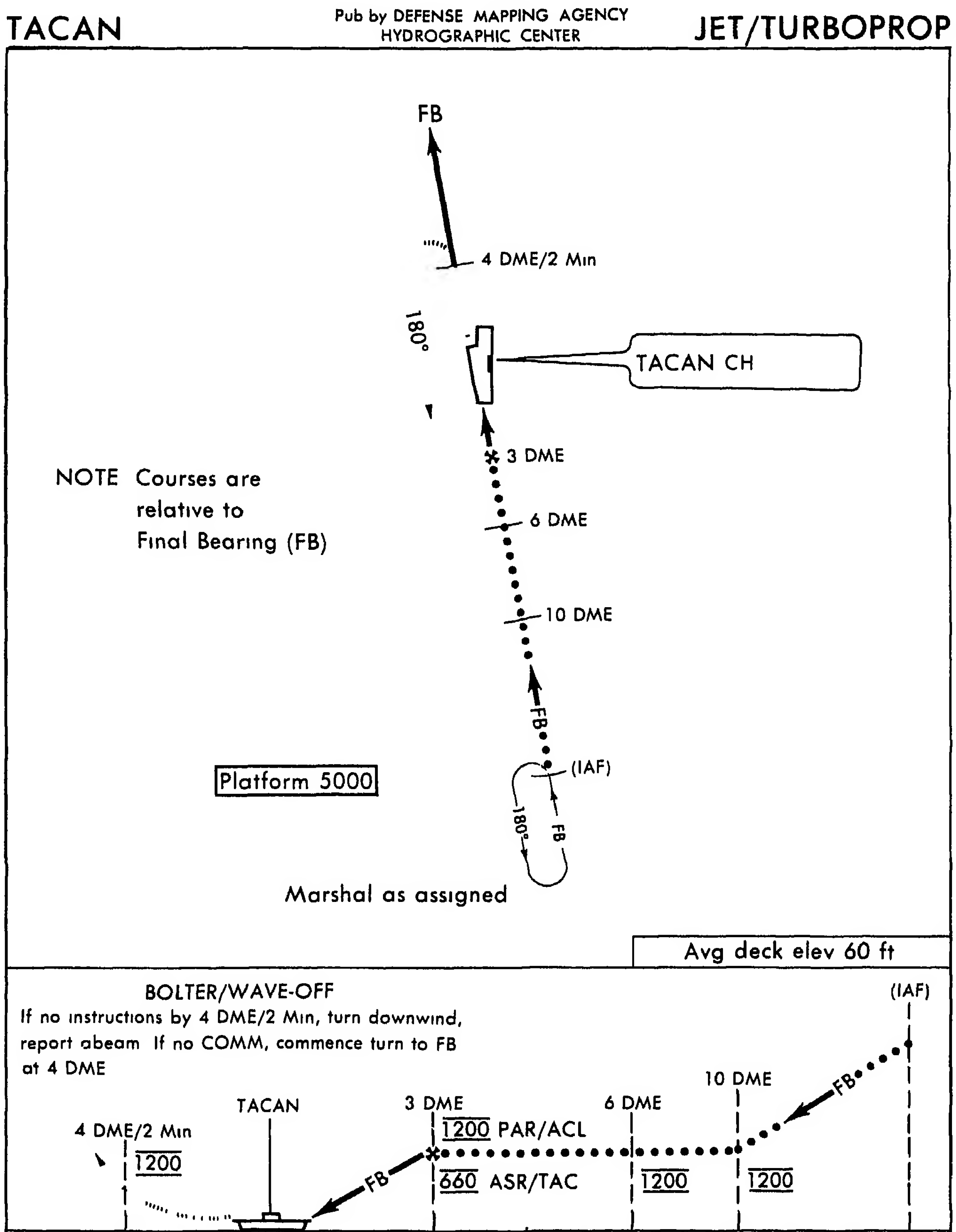
CATCC uses close control until the pilot is inside 10 miles and reports the ship in sight. CATCC shall be manned and prepared to assume control as a Case III recovery in the event the weather conditions deteriorate. The maximum number of aircraft in the landing pattern is limited to six. Penetrations in actual instrument conditions by formation flights of more than two aircraft are not authorized.

Flight leaders shall follow Case III approach procedures outside of 10 miles. At no time will the flights be cleared below 800 feet. When within 10 miles with the ship in sight, flights will be



202.22

Figure 14-1.—Legend Chart Aircraft Carrier Instrument Approach Procedure Charts.

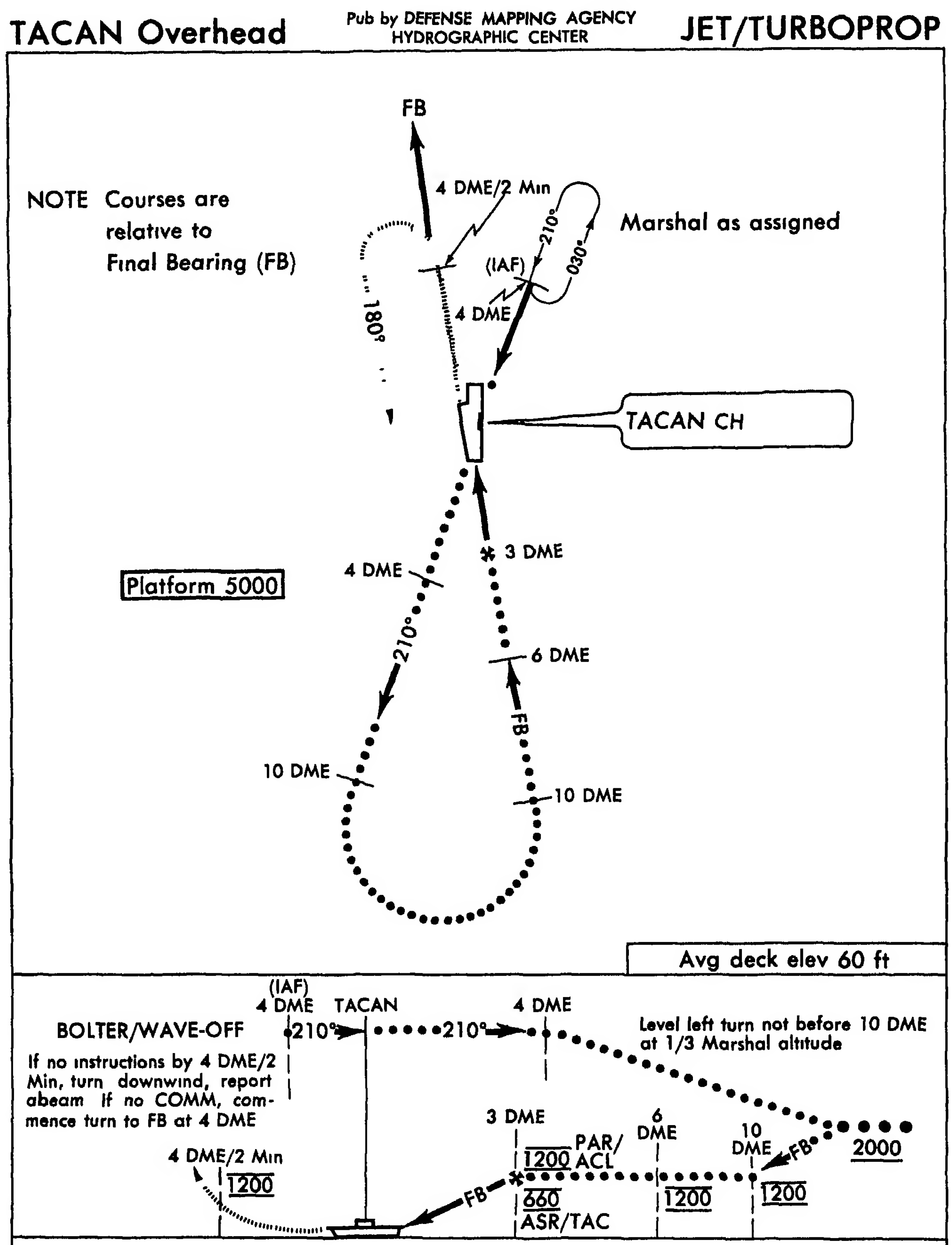


CATEGORY	JET		TURBOPROP	
S-PAR	260-½	200 (200-½)		
S-ACL				
S-ASR	660-1¼	600 (600 1¼)	460-1	400 (400-1)
S-TAC				

CV-1 Revised JUN 1972 TACAN

202.23

Figure 14-2.—Approach Chart CV-1 TACAN (Jet and Turboprop).



CATEGORY	JET	TURBOPROP
S-PAR / S-ACL	260-½ 200 (200-½)	
S-ASR / S-TAC	660-1¼ 600 (600-1¼)	460-1 400 (400-1)

CV-3 Revised JUN 1972 TACAN Overhead

202.36

Figure 14-3.—Approach Chart CV-3 TACAN Overhead (Jet and Turboprop).

hifted to tower control and will proceed as in Case I. If a flight does not have the ship in sight t 5 miles, both aircraft shall be vectored into the olter/wave-off pattern and action taken to conluct a Case III recovery for the remaining flights. Case II recoveries shall not be conducted concurently with Case III departures. Weather condiions permitting, helicopters may be assigned Case procedures concurrently with Case II and III ixed-wing operations.

Case III Recovery

CATCC controls the descent and approach. This type of recovery should only be made by ingle aircraft except in those cases where an ircraft with inoperative radio or navigational quipment is brought down on the wing of nother aircraft. Formation penetrations/ pproaches by different types of aircraft should ot be attempted except in extreme circumstances vhere a safer option is not available. Directing recovery in adverse weather conditions and vhere alternate airports are not available demands he utmost proficiency, mutual confidence, and ooperation between the pilot and controller.

Case III recoveries may be conducted concurently with Case I and II launches. During night VMC, helicopters may be cleared to the starboard olding pattern.

FINAL APPROACH

When precision approach radar is available, he precision final approach procedures are used by CATCC for Case III arrivals. In such cases, CCA furnishes the glidescope and azimuth infornation and controls the aircraft until it reaches PAR minimums or the LSO takes over. When precision approach radar or suitable visual anding aids are not available, an aircraft on final pproach will continue descent to 600 feet after passing the 6-mile DME fix. As the final controller, you must provide sufficient information o the pilot to maintain an accurate azimuth and ltitude until reaching nonprecision minimums.

Precision Final Approach

Jet and turboprop aircraft pass through the 5-mile DME fix at 1,200 feet, 150 knots in the landing configuration and commence slowing to final approach speed. The altitude of 1,200 feet is maintained at approach speed until intercepting the glidepath (approximately 3 miles, dependent upon the glide slope angle) unless otherwise directed by the final controller.

Propeller aircraft pass through the 3-mile DME fix at 1,200 feet in a landing configuration and maintain 1,200 feet until interception of the glidepath.

Helicopters pass through the 3-mile DME fix at 500 feet in a landing configuration and maintain 500 feet until interception of the glidepath, or until otherwise directed by the final controller.

ACLS Final Approach

NOTE: Automatic Carrier Landing System (ACLS) equipment is discussed later in this chapter.

MODE I APPROACH.—Mode I is a fully automatic approach to touchdown. At the 6-mile DME fix the pilot should engage the aircraft approach power compensator (APC) and automatic flight control system (AFCS). Normally at between 4 and 5 miles, the pilot receives via data link a LANDING CHECK discrete signal to indicate positive data link communications between the aircraft and ship. The ACLS controller acquires the aircraft between 3.5 and 5 miles, and the ACL READY/LOCKON discrete light illuminates. At that time, the ACLS controller shall report lockon with range; issue instructions as necessary for the aircraft to intercept the centerline; and instruct the pilot to report coupled. For example: "201 lockon, 5 miles, right ten, report coupled." With the aircraft in straight and level flight, within 10 knots of approach speed, and with a fly-up indication on his glide slope indicator, the pilot should engage autopilot coupler and report "Coupled".

In the event that the aircraft is unable to couple, the controller should continue with a Mode II or III approach.

The controller shall report sending commands. The COMMAND CONTROL discrete light illuminates, indicating the aircraft is receiving command signals via data link. The pilot shall acknowledge receiving data link commands by reporting "Command control." Thirty seconds

of coupled flight is desired prior to intercepting the glidepath. The controller should advise the pilot when approaching glidepath and may advise him of range each mile. The controller shall advise the pilot at minimums unless the LSO has previously assumed responsibility. The pilot shall respond with a ball report and include the word "Coupled". For example: "201 Phantom, ball, five point three coupled".

MODE IA APPROACH.—Mode IA is automatic to 200 feet/half-mile minimums with manual takeover to touchdown. Mode IA approaches are conducted the same as Mode I except the pilot uncouples at or prior to reaching the approach minimums and reports "Uncoupled". If the pilot uncouples at the ball call, he shall include the word "Uncoupling" in the ball report. For example: "201 uncoupling, Phantom, ball, five point three, manual/auto". When the pilot reports uncoupling, the controller shall downgrade the ACLS to Mode II.

MODE II APPROACH.—Mode II is a manual approach using ILS (Crossed needles) instrument presentation. Mode II approaches are conducted the same as Mode I/IA until receipt of the ACL READY/LOCKON discrete light. At that time the controller shall report lockon with range, and issue instructions to intercept centerline. For example: "201 lockon, 5 miles, right ten". The pilot shall report needle position. For example: "201 needles up and right". The controller shall concur or downgrade the approach to Mode III and advise the pilot. For example: "201, concur" or "201, disregard needles, downgrade to Mode III". The controller shall monitor the approach, advise the pilot when approaching the glidepath, and should inform him of the range each mile. The controller shall advise the pilot when at minimums unless the LSO has previously assumed responsibility. The pilot shall respond with a ball report.

ACLS Mode 2T approach is a manual approach using needles instrument presentation as well as Mode III information.

MODE III APPROACH.—Mode III is a CCA talkdown approach with no requirement for special aircraft configuration. The controller shall advise the pilot when at minimums unless the LSO has previously assumed responsibility.

HELICOPTER RECOVERY

Normally, helicopters will be recovered after all fixed-wing aircraft. Helicopters recovering after night plane guard duties should be provided positioning information by CATCC in order to expeditiously intercept the glide slope and effect a landing following recovery of the last fixed-wing aircraft.

On IMC recoveries the approach shall be flown as directed by CATCC until the pilot acquires visual contact with the optical landing aids, at which time he shall report "Ball". Control will then be assumed by the air officer, who shall issue final landing clearance. In the event of a waveoff, the pilot shall parallel the final bearing course and report to CATCC for control.

Helicopters should not be recovered while the ship is in a turn.

TANKER OPERATIONS

Tanker aircraft are assigned duties in support of the recovery of aircraft. Normally, a tanker that has just been launched will become the duty tanker for the recovery that follows immediately, provided that the tanker's store is operational (sweet). Those tankers which are known to have a good store and sufficient fuel to meet receiver requirements display a flashing green light.

A specific existing agency, for example departure control, is designated as tanker control and will have the responsibility of monitoring the following:

1. Tanker give-away fuel.
2. Tanker location.
3. Location and fuel requirements of the low-state aircraft.
4. Coordination of the tanker and receiver rendezvous.

EXERCISE

14-31. At what distance from the ship must transient helicopters contact the center?

14-32. What is the primary TACAN marshal fix for a jet at FL180, when the expected final bearing is 360°?

14-33. What is the lowest primary marshal altitude that may be assigned to a prop aircraft?

14-34. In the event of TACAN failure, what type of marshal may be assigned to arriving aircraft?

14-35. When must Case III recoveries be used?

14-36. What are the lowest approach minimums that a commanding officer may establish for a precision approach?

14-37. During a Case II recovery, when will CCA switch control of an inbound aircraft to Pri-Fly?

14-38. During what Case recovery does CCA control the descent and approach?

14-39. When PAR or suitable visual landing aids are not available, what action is expected of a pilot upon passing the 6-mile DME fix?

14-40. At what altitude and speed will jet/turboprops pass through the 6-mile DME fix?

14-41. Which Mode of an ACLS final approach is fully automatic to touchdown?

14-42. Which Mode of an ACLS final approach uses an ILS needles instrument presentation as well as Mode III information?

LPH OPERATIONS

ACs are frequently assigned to LHAs or LPHs whose operations are significantly different from CV operations. This section outlines some of the LHA/LPH air traffic control procedures contained in the LHA/LPH NATOPS Manual.

The LPH is primarily concerned with the transporting and delivery of marines and their helicopter-transportable equipment.

The air operations officer is responsible to the operations officer for coordination of all matters pertaining to flight operations and for the proper functioning of the Air Operations Control Center/Helicopter Direction Center (AOCC/HDC).

All flight preparations should be completed in sufficient time to permit the pilots to inspect, warm up, and check their aircraft prior to the scheduled launch time. More time is allowed for aircraft preparation under night or adverse weather conditions. Commensurate with this requirement and the EMCON plan in effect, AOCC should be manned in time to execute the following:

1. Check all the radio equipment, radar equipment, and NAVAIDs for proper operation and frequencies. Immediately report all the discrepancies for appropriate action, and advise the air operations officer and commanding officer if equipment failures will affect air operations.

2. Establish radio communications with shore activities on Raspberry, Air Defense Liaison, and other frequencies as applicable.

3. Test intercom, sound-powered, and teletype circuits.

4. Obtain weather for the operating area and shore stations within aircraft range. Advise meteorology of any special requirements for weather information during the day.

5. Update the aircraft status board. Advise the air operations officer, bridge, and flag plot if aircraft availability will seriously limit scheduled air operations.

6. Obtain PIM, and check its relation to the flight advisory areas and other control areas.

7. Check the message traffic for information which might affect the day's operations.

8. Check the air plan for any changes, and notify combat, cargo, and other stations concerned.

9. Check the clocks for proper time.

10. Check the pitlog and wind repeaters for proper operation.

11. Check all status boards for completeness and accuracy of information.

12. Ensure that squadron flight schedules have been received.

13. Provide the following information, as necessary, to the helicopter unit not later than 1 hour prior to scheduled launch:

a. Launch and recovery times.
b. Primary and alternate expected approach times.
c. Primary and alternate marshal/altitude.
d. PIM.
e. NAVAIDs status and frequency.
f. Ship's weather.
g. Weather at BINGO fields and en route.
h. Emergency data.
i. Air traffic control data.
j. Any restrictions or hazard to flight.
k. EMCON.
l. Pertinent information not included in the air plan.

DEPARTURE PROCEDURES

Aircraft normally launch on a departure frequency which is monitored by Pri-Fly at all times. Aircraft shall not be required to change frequencies or IFF codes until attaining both 300 feet in altitude and cruise configuration.

In IMC, helicopters shall launch at no less than 1-minute intervals and must climb straight ahead to a minimum of 300 feet and proceed on the 3-mile arc to intercept the assigned departure radial. They must proceed to their assigned departure radials which are based on the use of TACAN to provide lateral separation. The minimum standard separation of departure radials under instrument conditions is 20 degrees. Assignment of departure radials is normally dependent on:

1. Mission of aircraft.
2. Number of landing platforms in the formation.
3. Topographical features in the area.
4. Those radials reserved for emergencies, letdowns, or holding patterns. Direct routing must be used as much as possible to lessen delay in the execution of departure.

ARRIVAL PROCEDURES

On entering the LPH control area (50-mile radius), inbound flights are required to report to AOCC/HDC for clearance into the control zone (5-mile radius up to and including 2,500 feet).

Marshal

Every effort should be made to anticipate weather conditions and provide marshaling in visual conditions if practical. Aircraft below an overcast should not be required to climb into the overcast in order to comply with altitude limits, if AOCC/HDC can safely exercise control below the overcast. Those aircraft above an overcast should be assigned altitudes above the overcast and retained in formation when possible. Formation flights will be limited to a maximum of four aircraft at any one assigned altitude. Under instrument conditions, a section of two aircraft is the maximum number authorized in any one flight.

Unless otherwise specified in the operations orders or instructions issued by AOCC/HDC, the marshal pattern shall be a right-hand racetrack pattern, holding between the 5- and 7-mile fixes.

The inbound leg shall pass over the marshal fix. Helicopters shall be separated vertically by a minimum of 500 feet. Fixed-wing aircraft shall be separated vertically by a minimum of 1,000 feet. LPH TACAN marshals are as follows:

1. The TACAN marshal number one is on the 180° radial relative to the base recovery course at a distance of 5 miles; altitude as assigned.

2. The TACAN marshal number two is on the 270° radial relative to the base recovery course at a distance of 5 miles; altitude as assigned.

3. The TACAN marshal number three is on the 090° radial relative to the base recovery course at a distance of 5 miles; altitude as assigned.

4. The NDB marshal is an overhead holding pattern, inbound 180° relative to the base recovery course; altitude as assigned.

Approach Criteria

The air operations officer determines the type of approach and required control in accordance with established criteria. Weather in the approach area is the most prominent factor influencing this decision. The criteria for approaches are as follows:

1. Visual descent/approach may be used only when it can be anticipated that flights will not encounter instrument conditions at any time during the descent, break, and final approach. The pilot retains full responsibility for the proper navigation and separation from other aircraft. He shall be advised of expected Charlie time and switches to tower control after reporting the ship in sight.

2. Controlled descent/visual approach will be used during daylight hours when weather conditions are such that flights may encounter instrument conditions during the descent, but visual conditions exist at the ship where visual break and final approach can be made safely. Close control shall be used until the pilot reports the ship in sight.

3. Controlled descent/approach shall be used when conditions requiring close control exist. These conditions are as follows:

a. Ceiling of 500 feet or less.

b. Forward flight visibility of 1 mile or less.

c. All flight operations between 1/2-hour after sunset and 1/2-hour before sunrise except as modified by the officer in tactical command or the commanding officer.

Approach Minimums

The commanding officer establishes the approach minimums which reflect significant changes in operations capabilities, such as decreased proficiency of the AOCC/HDC or embarked helicopter units. However the absolute minimums are as follows:

1. PAR—200:1/2
2. NON PAR—300:3/4

When a suitable BINGO field is available, the aircraft shall not commence an approach if the reported weather is below absolute minimums unless the aircraft has sufficient fuel to proceed to the BINGO field in the event of a missed approach.

Approach Procedures

VISUAL DESCENT/APPROACH.—Flight leaders must report when the ship is in sight, at which time AOCC/HDC must switch the flight to land/launch frequency for Pri-Fly control.

CONTROLLED DESCENT/VISUAL APPROACH.—AOCC/HDC controls the descent until visual conditions are reached, or to approach minimums, whichever occurs first. The pilot should place his transponder on normal and report when he has sighted the ship. The pilot is then shifted to land/launch frequency for tower control.

CONTROLLED DESCENT AND APPROACH.—This type of recovery should be made with single aircraft only, except in those cases when an aircraft with inoperative radio

or navigational equipment is brought down on the wing of another aircraft. The following procedures are mandatory:

1. AOCC/HDC shall ensure that the following information has been provided to each aircraft prior to commencing the approach:

   a. EAT.
   b. Altimeter setting.
   c. Final control frequency.
   d. Type of approach.
   e. BRC.
   f. Time check.
   g. Ceiling, visibility, and deck conditions.
   h. Other pertinent data.

2. Unless weather or operating circumstances dictate otherwise, aircraft departing the same marshal are separated by 1 minute.

3. Except in emergency conditions, changes in radio frequencies/IFF codes shall be made no later than marshal.

4. Each pilot will adjust his pattern to depart marshal at the assigned EAT. Early or late departures are reported to approach control immediately, so that adjustment in interval can be made.

5. Helicopters shall descend at 500 feet per minute from marshal to an altitude of 500 feet at the 3-mile DME fix.

PRECISION FINAL APPROACH.—Helicopters shall pass the 3-mile DME fix at 500 feet in a landing configuration and maintain 500 feet until otherwise directed.

Standard ATC and GCA phraseology shall be used with the exception of altitude which is reported in angels. Fuel state is reported in hours and minutes to fuel exhaustion.

CCA EQUIPMENT

Learning Objective: **Recognize the uses of CCA equipment.**

RADAR

Models of radar equipment vary somewhat from ship to ship; however, just as we discussed in chapter 12, two basic types of radar are common—air search and precision. In addition, automatic systems are also in use.

Search Radar

Generally speaking, most carriers have a variety of air search radars on board. Some types are long range (up to 240 miles) and others are medium range (50 to 60 miles). In some cases, CIC and CCA share the use of shipboard radars—CIC for their air intercept work, and CCA for air traffic control.

Shipboard air search radars have IFF/SIF Radar Beacon Systems which provide the same capabilities as the ATCRBS/DAIR equipment discussed in chapter 12. This equipment is referred to as CATCC/DAIR.

The obvious difference between radars used on board ships and radars used ashore is that shipboard radars are on a continuously moving airfield. For this reason, most shipboard radars are gyroscopically and/or computably stabilized. This allows the presentation you see on the radar repeater to remain orientated (magnetic north at the top of the scope) even though the ship is in a turn. There is also a ship heading marker/cursor displayed on the scope which changes automatically as the ship changes course.

The radar repeaters used on board ship have the same features as those used ashore; i.e., variable range control, off-center sweep and cursor, and range strobe. In addition, up to seven different radar presentations may be selected by the controller.

Precision Radar

While controlling a CCA approach, it is the responsibility of the CCA final controller to position each aircraft on final as near as possible to the centerline of the carrier angle deck, by giving right or left corrections. The final controller should have the aircraft on the course line and holding a good heading prior to reaching a point 1 1/2 miles from the carrier.

Large azimuth corrections, to get back to the oncourse, should be avoided in the final stages of the approach. Carrier approaches are a critical phase of aircraft operation, and erratic maneuvers

at slow speeds usually prove ineffectual, if not disastrous.

The secret of a smoothly controlled approach is to assign large heading changes, as required, while the aircraft is at least 3 miles or more from the ship. If this technique is used, only small corrections should be needed when the aircraft gets closer.

When the pilot has the ball in sight and is prepared to complete the approach visually, he will transmit BALL. The controller ceases transmission, and the pilot then adjusts his descent to put the ball in line with the datum lights and makes any necessary azimuth corrections. The pilot continues to visually fly the ball to an arrested landing.

A versatile CCA precision radar in service today is the SPN-35. Figure 14-4 illustrates the radar indicator used with the SPN-35 equipment. Two indicators of this type are installed in the CCA control room—one being the MASTER indicator and the other the SLAVE indicator. An important feature of the SPN-35 is the controller's capability to select simultaneous scan—that is, one indicator displays precision while the other displays surveillance.

NOTE: The search portion of the SPN-35 is relative to the ship's heading.

With a stabilization system as an integral part of the equipment, any pitching or rolling of the ship is compensated for, thus maintaining a constant glide slope.

The azimuth portion provides two choices of scan: normal (30°) and 60° AZ. In the normal position the azimuth sweep scans 25° to the portside and 5° to the starboard side of the ship as viewed by the pilot. This sweep is more desirable as it allows the controller to see aircraft turning to final from the downwind position during a bolter/waveoff pattern.

When the 60° AZ scan is selected, the additional 30° of azimuth coverage is to the starboard side of the ship, requiring twice the length of time to complete this coverage. Therefore, this position of operation is the least desirable.

Automatic Carrier Landing System (ACLS)

The ACLS is a combination of several systems developed independently, each of which performs a significant function in the complexity of automatic landings. The ACLS consists of a precision tracking radar, coupled to a computer data link to provide continuous information to the aircraft, and an independent beam scanning the transmitters which provide the pilot with a monitoring capability and a backup approach system.

The SPN-10 was the first radar system developed to provide the carrier landing capability described in the preceding paragraph. Since its development, system reliability has continuously improved through testing and newly acquired technology. The latest improvement concerns the conversion of the SPN-10 to a digital system using solid state radar. This converted system has been designated the SPN-42.

SPN-42.—In addition to precision tracking radar, the SPN-42 consists of the necessary electronic equipment to provide a completely automatic landing capability. When an aircraft is approaching a carrier, the precision tracking radar monitors the aircraft's progress and feeds the position information to a computer. There the aircraft's position is measured in relation to a preselected approach path. The computer determines what corrections are necessary to maneuver the aircraft to the desired path and transmits this information to the aircraft by radio. Equipment in the aircraft feeds the commands through an autopilot to the aircraft's control surfaces and throttle, and the aircraft reacts accordingly. (See figure 14-5.) This same information, in addition to intelligence concerning the distance from the ship to the aircraft, is also fed to the CCA operator's console.

An example of the operator's console is shown in figure 14-6. This information may also be presented on an ILS-type instrument display for the pilot, as a visual presentation of error information and corrections to be made. Thus, the modes of operation available for landing approaches are—(1) fully automatic, (2) manual approach similar to a conventional ILS-type approach, and (3) conventional CCA approach

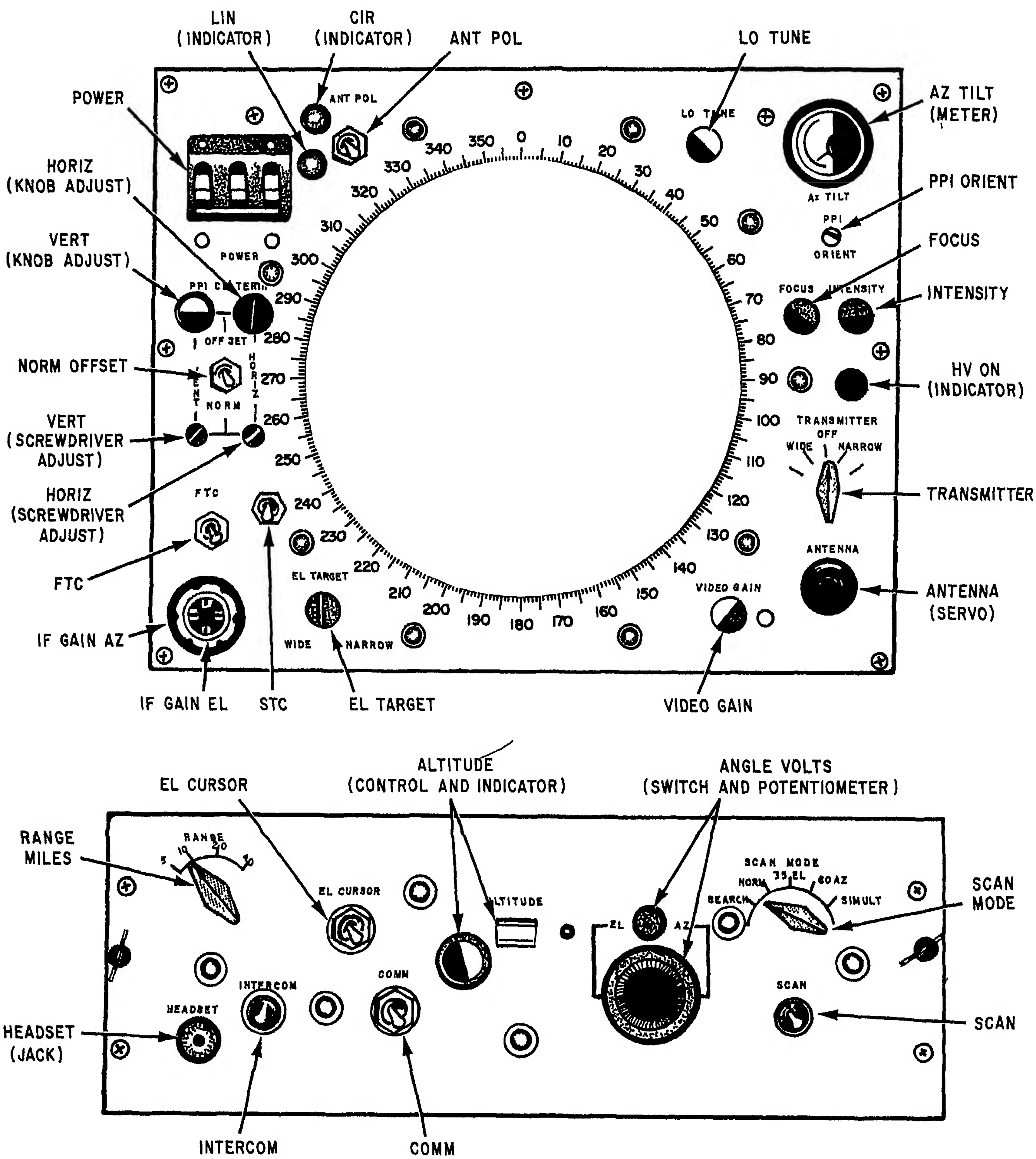


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Figure 14-4.—SPN-35 radar indicator.

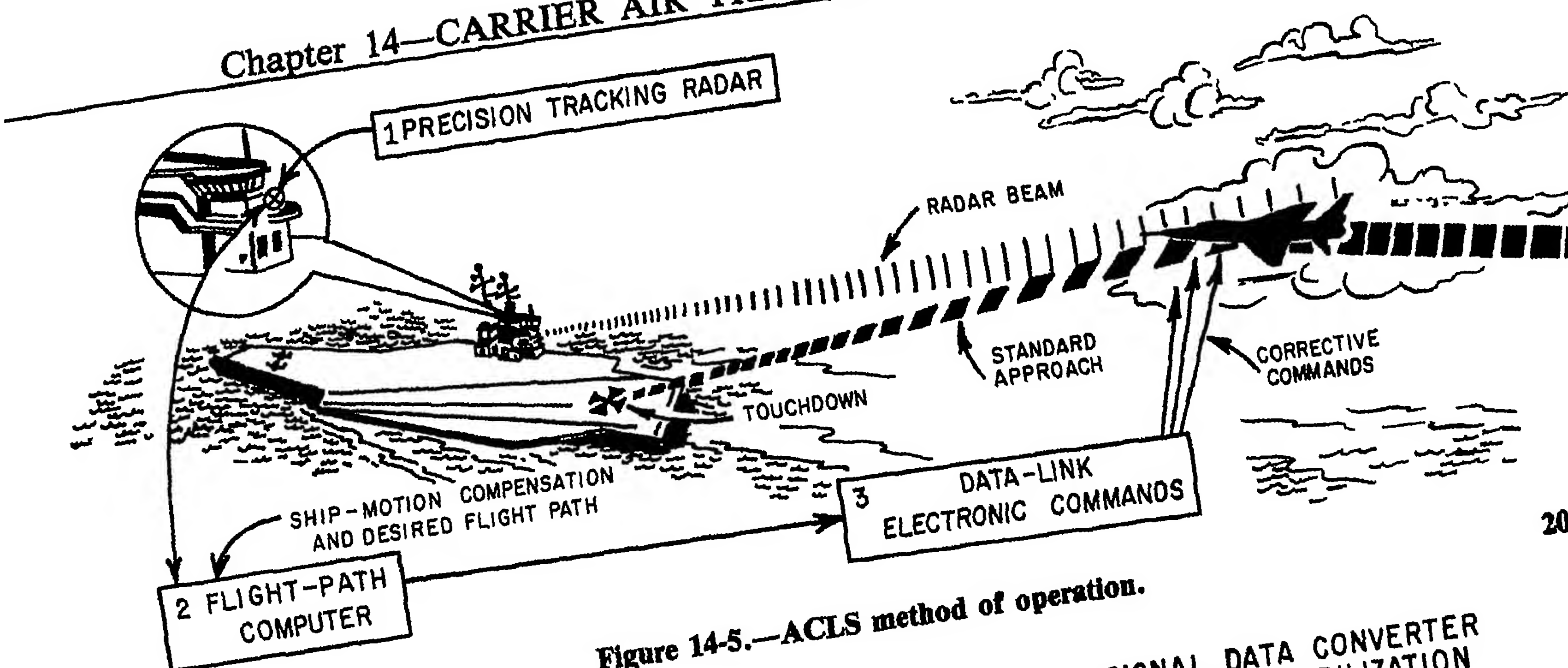

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Figure 14-5.—ACLS method of operation.

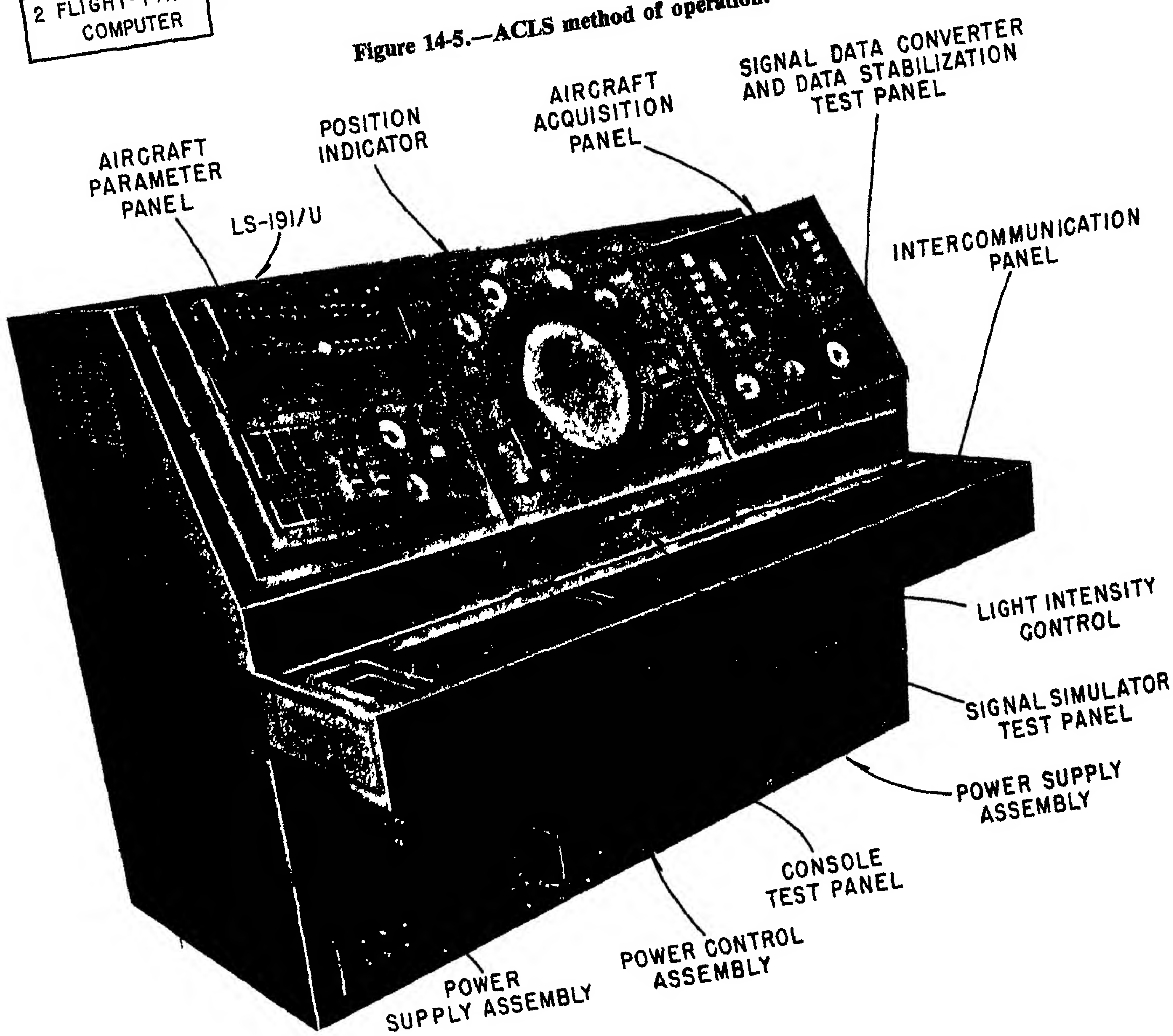

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Figure 14-6.—ACLS operator's console.

in which the aircraft is talked down by the controller.

SPN-41.—The need for the pilot to monitor his progress during a fully automatic approach was recognized early in the development of ACLS. To provide the pilot with this capability, the SPN-41 was developed. This is a completely independent guidance system which, in addition to providing a means for monitoring, affords the pilot another method of making an instrument approach to the ship. In this system, shipboard transmitters scan coded microwave signals aligned on the desired approach path. On the aircraft's instrument panel, the information from this system is displayed on an ILS-type instrument. This is illustrated in figure 14-7. The SPN-41 provides guidance information in excess of 20 miles. This type of approach requires the pilot to transfer to a visual landing aid, such as the Fresnel lens system, prior to touchdown as would Mode II or III approaches using the SPN-42.

With both the SPN-41 and SPN-42 installed in aircraft and ships, the SPN-41 serves as a feeder and monitor system for the ACLS. The SPN-41 furnishes the pilot with information on the same ILS-type instrument as does the SPN-42 for a mode 2 operation. Since Modes I and II may be lost or the data link system could possibly fail in the SPN-42 system, the SPN-41 provides backup for continuation of a Mode II type of approach should an equipment failure occur while an aircraft is on an approach.

Of course, the ever-present CCA controller monitors the entire system on the operator's console and is always there to make the transition to a Mode 2T or conventional talkdown approach when necessary or desired.

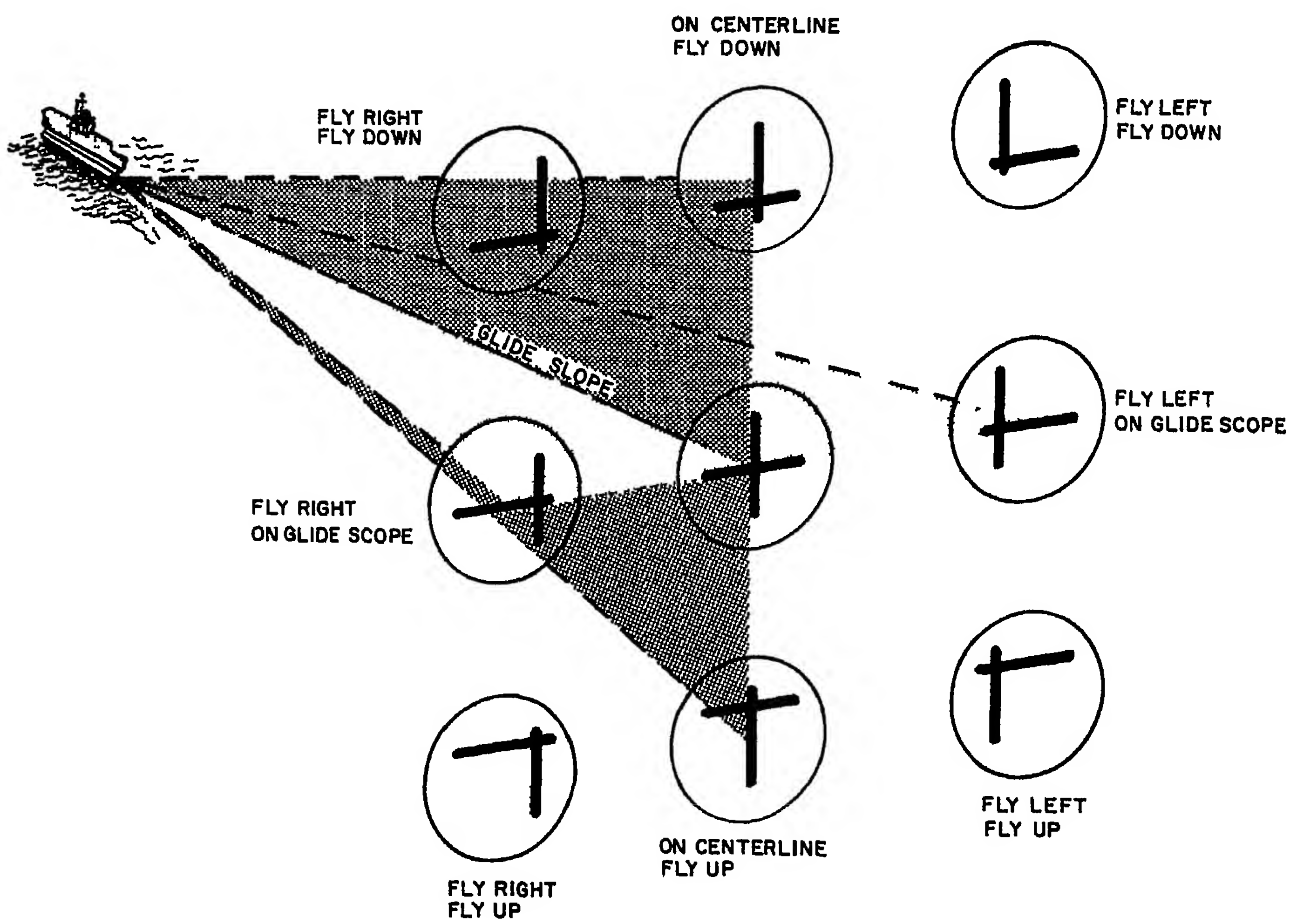

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Figure 14-7.—SPN-41 approach system.

ANCILLARY EQUIPMENT.—Ancillary equipment that is normally located in the CCA control room includes the following:

1. Communications consoles—models of equipment vary but their function is equivalent to those consoles discussed in chapter 10.
2. Gyro repeater—indicates the ship's true course.
3.. Deck condition lights—indicate ready or fouled deck.
4. SPN-44 radar—indicates the airspeed of aircraft on final, either true or closing, as selected by CCA or the LSO.
5. Pilot Landing Aid Television (PLAT) and CCTV receivers.

NOTE: This equipment is discussed later in this chapter.

6. Vertical edge lighted status board—its purpose was outlined under the duties of the status board keepers.
7. 15G21 CATCC/DAIR simulator—a training simulator designed for shipboard use, which basically provides the same functions as the 15G20 discussed in chapter 12.

OPTICAL LANDING SYSTEMS

Fresnel Lens Optical Landing System (FLOLS)

The purpose of the lens system is to provide the pilot with a visual indication of his relative position with respect to a prescribed glide slope. This glide slope, as determined by the lens settings, is designed to bring the aircraft down to the deck, within the crossdeck pendant pattern, with a safe arresting hook clearance above the stern ramp of the carrier. Figure 14-8 illustrates the Fresnel lens unit.

A yellow bar of light is displayed over the full width of the lens box. The lens box may be considered a window through which the pilot views the bar of light. The bar of light appears as though it were located approximately 150 feet beyond the window. When viewed from anywhere on the prescribed glide slope, this bar of light (ball) will appear in line with the green datum lights. The ball rises above the datum lights as the pilot rises

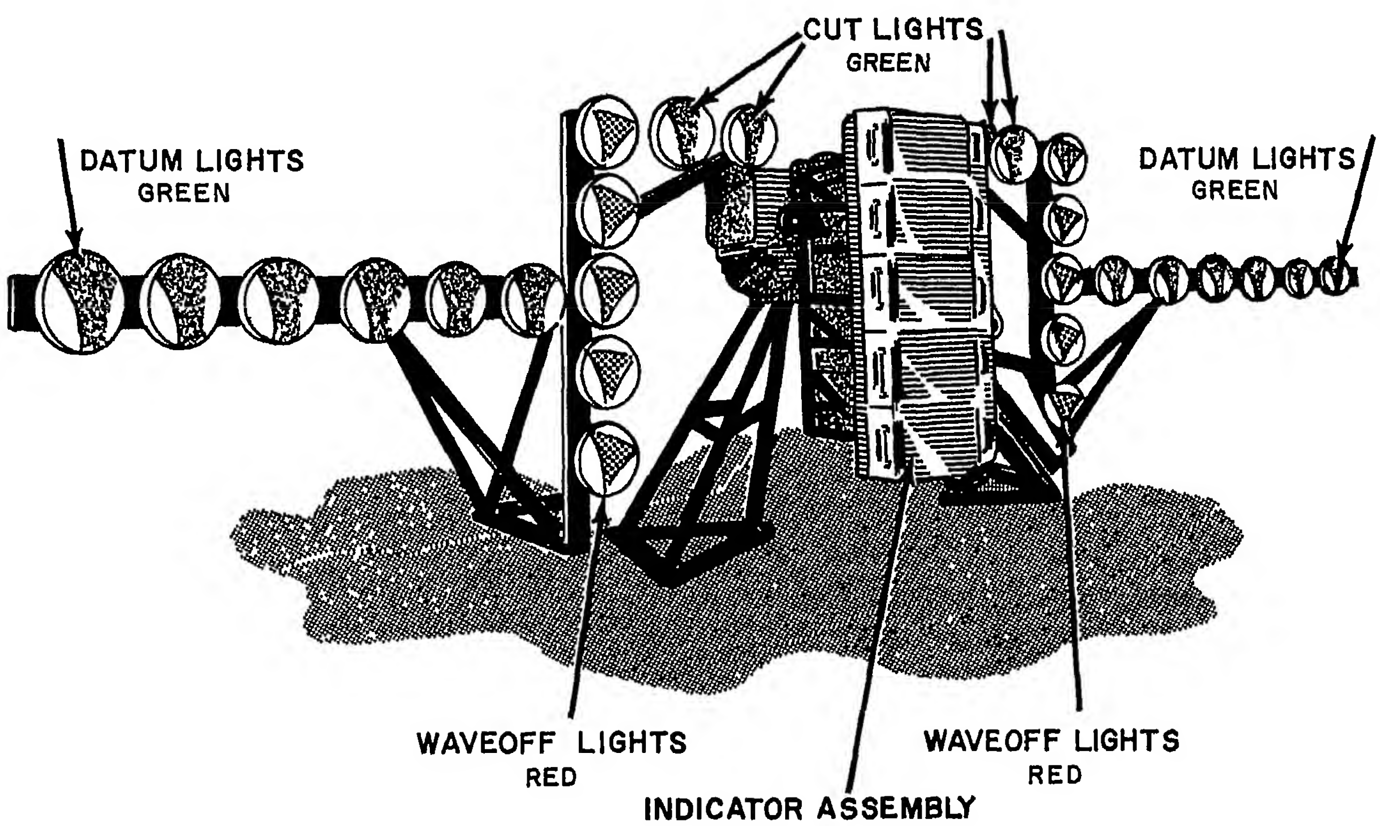

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Figure 14-8.—Fresnel lens unit.

above the glide slope, eventually sliding off the top of the lens box when the pilot is more than three-fourths of a degree above the glide slope. The same holds true as the pilot drops below the datum lights and finally slides off the bottom of the lens box. To sum up, when the ball is high (above the datum lights), the pilot is above the glide slope. When it is low, the pilot is below the glide slope. In either case, the object is to line up the ball with the datum lights.

At great distances from the lens unit, it is difficult to distinguish the relative position of the ball with respect to the datum lights, because the ball can be distinguished before the green datum lights become visible. Pilots are therefore provided with a warning of low ball by installing a RED lens in the bottom cell of the lens box. Thus, regardless of distance, when the ball is RED instead of YELLOW, a pilot will know he is too low or too high.

Manually Operated Visual Landing Aid System (MOVLAS)

MOVLAS is an emergency signalling system intended to be used when the primary optical landing system is rendered inoperative. The system is designed to present glide slope information to the pilot of an approaching aircraft in the same visual form presented by the Fresnel Lens Optical Landing System (FLOLS). As a substitute for FLOLS, the MOVLAS has three modes of operation.

Mode I consists of a light box installed directly in front of the FLOLS lens as a substitute for the normal ball presentation but still using the datum, waveoff, and cut lights of FLOLS. Mode II is completely independent of the FLOLS. It is located between 75 and 100 feet aft of the inoperable system and consists of reference datum, waveoff, and cut lights in addition to the ball presentation. Mode III installation is similar to Mode II but is located on the starboard (right) side of the flight deck, aft of the island structure.

PLAT System

Another system which complements the FLOLS and which is a beneficial landing aid is the Pilot Landing Aid Television (PLAT). It provides, through various pickup and monitoring units, an instant picture of all landings, plus the capability of tape recordings for future replays. Figure 14-9 shows a typical installation of a PLAT system.

The heart of the PLAT system is the ship's closed circuit television (CCTV), which consists basically of four cameras (pickups), monitors control synchronization, a video tape recorder and associated power and distribution systems

CENTERLINE CAMERA.—The centerline camera pickup station is unmanned and consist of two units (primary and backup) which provide instantaneous (real-time) monitoring of aircraf landings (figure 14-9). The point-in-space (window) viewed by the centerline cameras i stabilized to compensate for the pitch and roll o the ship. The FLOLS previously discussed i gyroscopically stabilized to maintain a constan reference to the earth's horizon, regardless of th pitch/roll due to sea state, ship maneuvers, etc Both centerline cameras obtain stabilization fron the same source as the FLOLS. This stabilization within the limits of its corrective ability, compensates for the camera motion so that the camera' field remains on target, regardless of the ship' pitch/roll. From their centerline position, thes cameras follow the aircraft from approach t touchdown.

ISLAND CAMERA.—This pickup unit, a shown mounted on the superstructure in figur 14-9, is manned by an operator and provide monitoring of aircraft side numbers in additio to recording launches, general flight dec activities, and accidents. It takes over coverag at touchdown, and the data from this pickup the provide a final coverage of the landing.

MONITORS.—Monitoring units such as th ones shown in figure 14-9 are located in variou compartments throughout the ship. Typical locations are the pilots' readyrooms, CCA, Captain' Bridge, CIC Room, and the LSO's platform Distribution of the "topside activity" in thi manner provides a convenient observation medi for the general situation on the flight deck. A even greater feature is the availability of th transmitted data to widely dispersed locations/personnel; this contributes considerably t

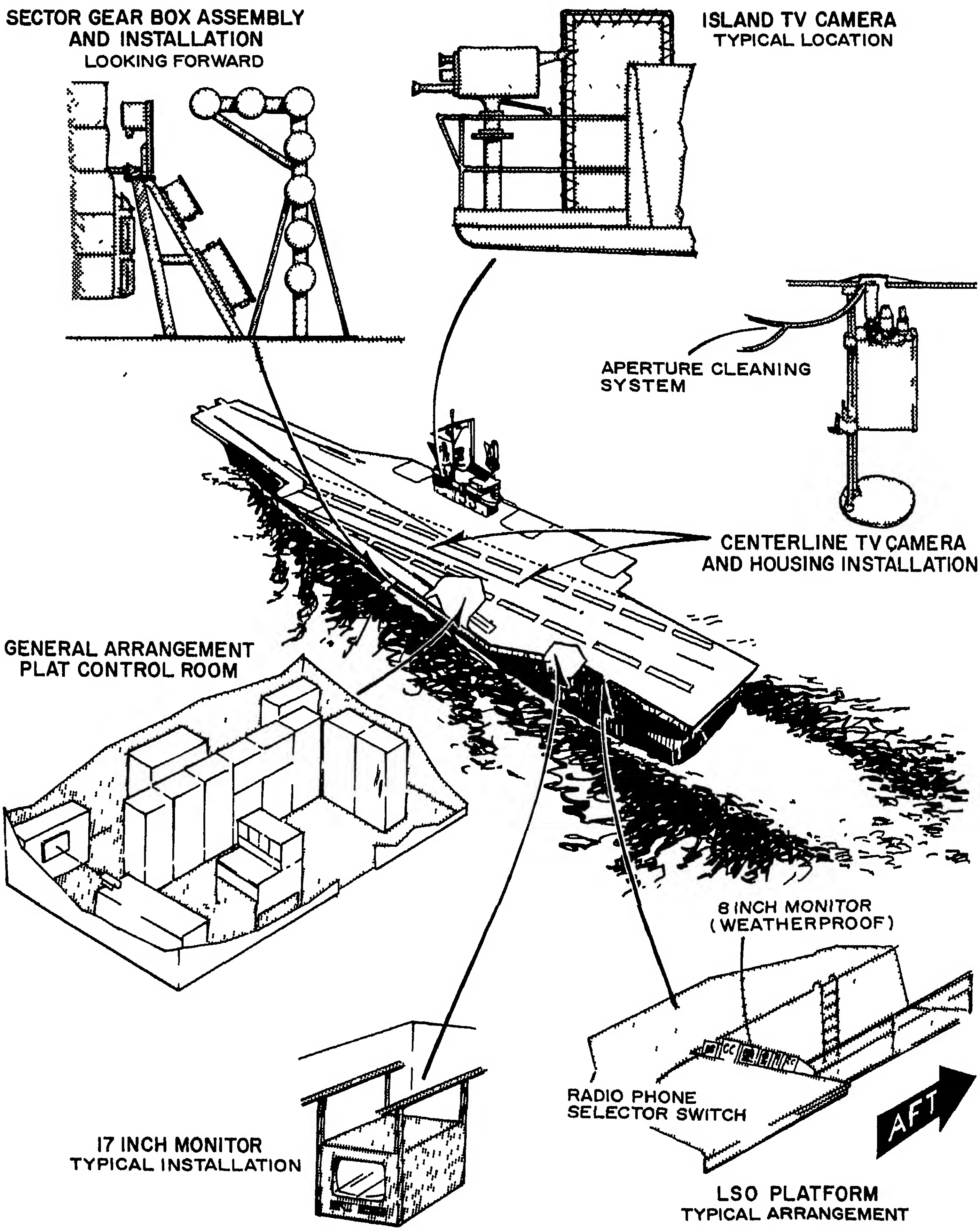

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Figure 14-9.—PLAT system.

a more smoothly coordinated team effort throughout the ship. Additionally, all data are simultaneously recorded; the tapes may then be stored for later use as debriefing material and as training aids. In this way the system helps to avoid/correct human errors and contributes to safer carrier landings.

EXERCISE

14-43. The IFF/SIF beacon system used on board a CV is referred to as what?

14-44. When using PAR radars to control arriving aircraft, at what point on final approach should the final controller have the aircraft on the course line and holding a good heading?

14-45. At what point on the final approach will the controller cease transmissions and the LSO take over?

14-46. What is the designation of the shipboard radar which consists of the necessary electronic equipment to provide a completely automatic landing capability?

14-47. What is the designation of the shipboard radar which provides a pilot with a means of monitoring ACLS approach?

14-48. What is the purpose of the FLOLS?

14-49. How many TV Cameras does the PLAT consist of?

14-50. Describe how the PLAT system can be beneficial as a landing aid and for training?

APPENDIX A

ANSWERS TO EXERCISES

1-1. The AC rating is a general rating and is included in Navy Occupational Field 7.

1-2. Air traffic control facilities provide control tower, radar control, and flight planning services.

1-3. On carriers, flight planning services are normally provided by the Air Operations (AirOps) branch.

1-4. The minimum requirements that you must meet for entry into the AC rating are:

1. Pass a Second Class medical examination.
2. Possess an Airman Written Test Report for Control Tower Operator (AC Form 8080-2), and/or be a graduate of a formal basic air traffic controller course of the Navy, another branch of service, or agency.
3. Be eligible for access to classified information.

1-5: AC-0000.

1-6. To be assigned an AC-6902 NEC, the individual must be a graduate of the CATCC Controller course and qualified in all CATCC control positions.

1-7. FAR Part 67.

1-8. One year (12 calendar months).

1-9. Control Tower Operator Certificate (AC Form 8060-1) with CTO rating.

1-10. OPNAVINST 3721.1, FAR Part 65 and FAAH 7220.1

1-11. CTO.

1-12. RATCF, Radar Air Traffic Control Facility rating.

1-13. (a). CTO Examiner.
(b). The Commanding Officer or his designated representative.

1-14. (a). The FAA.
(b). CNO.

2-1. a. Be at least 18 years of age;
b. Be of good moral character;
c. Be able to read, write, and understand the English language and speak it without accent or speech impediment;
d. Hold at least a second class medical certificate issued within the last 12 months; and
e. Pass the Airman Written Test for Control Tower Operator.

2-2. The FAA Administrator is the final authority for issuing and revoking CTO certificates. However, issuing authority is normally delegated to CTO Examiners, and revoking authority is delegated to FAA Regional Examiners.

2-3. Offenses involving; (1) narcotic drugs, marijuana, and depressant or stimulant drugs or substances, (2) cheating or other unauthorized conduct when taking examinations for a certificate or rating, and (3) fraudulent or false statements or records on any application, certificate, or rating issued under Part 65.

2-4. 120 days.

2-5. To keep any facility rating current, you must control air traffic within the limitations of that rating for at least 3 of the preceding 6 months, or show that you still meet the requirements for your certificate or rating.

2-6. 60 days.

2-7. You must give the Airman Certification Branch a written statement of your new permanent mailing address within 30 days after any change.

2-8. a. Serve as a control tower operator without a facility rating for at least 6 months, or

b. Serve as a control tower operator with a certificate/rating at a different control tower for at least 6 months before the date of application.

c. Be a military controller who has served satisfactorily as an air traffic control tower operator for at least 6 months.

2-9. 30 days.

2-10. <u>CONTROL TOWER</u>

Flight data	80
Ground control	80
Clearance delivery	80
Local control	+160
	400 PTHs

2-11. You may issue IFR control clearances if you have received authorization from the ATC facility having IFR control responsibility for your location.

2-12. Whenever you are performing ATC duties.

2-13. Ten consecutive hours or 10 hours during a period of 24 consecutive hours, unless you have had a rest period of at least 8 hours at or before the end of 10 hours of duty.

2-14. Federal airways extend from (a) not less than 1,200 feet AGL, (b) up to but not including 18,000 MSL.

2-15. Eight nautical miles (4 nautical miles each side of the center line).

2-16. Federal airways are depicted on En Route Low Altitude charts much like interstate highways are shown on road maps. They are identified by the letter "V" and a number.

NOTE: Generally even numbers identify East-West airways, and odd numbers North and South.

2-17. The vertical limits of jet routes are from flight level (FL) 180 up to FL 450 inclusive. They are identified on En Route charts by the letter "J".

2-18. In controlled airspace air traffic control procedures and authority are provided. In uncontrolled airspace, ATC does not have authority nor responsibility to exercise control over air traffic.

2-19. a. Special use airspace
b. Controlled airspace (Difference equals 1,200 feet)
c. Controlled airspace (Difference equals 1,500 feet)
d. Controlled airspace
e. Controlled airspace

2-20. Areas designated as Restricted Areas are over land where Warning Areas are over international waters. Flight of aircraft within an RA, while not wholly prohibited, is subject to restrictions. Flights within a Warning Area, because they are over international waters, cannot legally be restricted.

2-21. At a minimum, two. GFRs and either VFRs or IFRs, as appropriate. In addition, over the high seas, they must comply with the rules of Annex 2 of ICAO.

2-22. The pilot in command is directly responsible for, and is the final authority as to the operation of an aircraft.

2-23. a. The aircraft in the process of landing has the right-of-way over aircraft on the surface. The Navy jet priority authorization can be used "whenever feasible" and is NOT a right-of-way rule.
b. When two aircraft are approaching head on, each pilot should alter course to the right.
c. When two aircraft of the same type are converging at approximately the same altitude, the aircraft on the right has the right-of-way.

2-24. In general terms, any aircraft maneuver not required for normal flight which involves an abrupt change in an aircraft's altitude or attitude, intentionally performed spins, or quick turns or accelerations are considered to be acrobatic.

2-25. 200 KIAS.

2-26. Navy pilots are encouraged by OPNAVINST 3710.7 to show landing lights during daylight hours when weather conditions permit.

2-27. It is an advantage to you because it highlights the presence of air traffic in the traffic pattern.

2-28. 1,000 feet above the highest obstacle with a radius of 2,000 feet from the aircraft.

2-29. None specified; however, the aircraft is not to be flown closer than 500 feet to any person, vessel, vehicle, or structure.

2-30. 29.92 inches.

2-31. A pilot may deviate from the rules of FAR 91 (1) in an emergency, (2) when a military necessity exists, and (3) when the FAA grants a certificate of waiver. If a pilot in an emergency deviates from FAR, Part 91, that pilot must, if requested by the Administrator, submit a written report of the deviation.

2-32. Only in an emergency. Then the pilot must notify ATC as soon as possible. If ATC priority resulted, and ATC requested, the pilot must submit a detailed report within 48 hours to that ATC facility.

2-33. Yes, table 2-2 indicates that maintaining a position 500 feet above cloud tops is improper. It does indicate that 500 feet below or 1,000 feet above is proper. The reason is simple, should an aircraft be climbing IFR up through these clouds, neither would have much of a chance to see and avoid each other.

2-34. Yes, cruising VFR above 10,000 feet requires 5 miles flight visibility.

2-35. Land, take off, and flight through a control zone.

2-36. They are allowed only in a control zone.

2-37. Ground visibility must be at least 1 mile to authorize takeoff or landings (1/2 mile, if the aircraft is an air carrier), and in the case of aircraft transiting the control zone, the pilot reports flight visibility of at least 1 mile.

2-38. When they are being operated at 3,000 feet or above.

2-39. No, Westbound traffic adheres to even thousands of feet, plus 500. In this case, either 14,500 or 16,500 is correct.

2-40. The pilot must remain VFR until an IFR flight plan can be air filed and an IFR clearance obtained.

2-41. Yes, any flight which penetrates PCA requires an IFR flight plan and clearance.

2-42. Yes, after you give the reported official weather, it is then the pilot's responsibility to decide if the weather meets their minimums.

2-43. a. No minimums are specified; takeoff depends on pilot judgement and urgency of flight,

b. 300 feet and 1 mile, unless a PAR approach is available. However, the absolute minimums in this case are 200 feet and 1/2 mile.

2-44. The lowest altitude along a route of flight which permits a safe flight.

2-45. It is the published MEA or MOCA.

2-46. a. 7,500 feet

b. at the altitude assigned by ATC

c. Either 7,000 or 9,000 feet

2-47. In this case, you are responsible for keeping approaching pilots informed of the new weather as soon as it is made available.

2-48. Prevailing visibility is the controlling visibility for all approaches which require circling to another runway.

2-49. Whenever the pilot operates IFR in controlled airspace.

2-50. Whichever facility has authority over the airspace in which the flight will take place.

2-51. Departure procedure, route of flight, altitude data, holding instructions, any special information, radio frequency, and beacon code assignments.

2-52. FAR, Part 99

2-53. When the aircraft will operate at a TAS of less than 180 knots and the pilots maintain a listening watch on an appropriate radio frequency.

2-54. This aircraft will penetrate a Domestic ADI2 and the tolerances are:

1. Time—within 5 minutes of the estimated time of penetration, and
2. Position—within 10 nautical miles of the estimated point of penetration.

2-55. Normal IFR position reports.

3-1. The troposphere, however, some thunderstorms will break into the lower stratosphere.

3-2. Due to the forces of gravity and the weight of the atmosphere, pressure is greater at sea level and decreases with any increase of altitude.

3-3. 29.92 inches of mercury which equals to 1,013.25 millibars.

3-4. Low-pressure systems (cyclones) produce the most severe weather.

3-5. a. Continental Tropical
b. Maritime Tropical or Equatorial
c. Continental Polar
d. Maritime Polar

3-6. a. Cirrocumulus (Cc)
b. Altocumulus (Ac)
c. Nimbostratus (Ns)
d. Cumulus (Cu) and Cumulonimbus (Cb)

3-7. Cumulonimbus Mammatus (CBMAM) indicate extreme turbulence and are associated with severe thunderstorms and/or tornadoes.

3-8. Often thunderstorms and severe weather occur because of the violent collision of cold and warm air, especially in mid America. Other conditions are a steady fall in temperature.

3-9. A wind shift usually marks passage, accompanied by an abrupt increase in pressure.

3-10. Warm frontal weather; primarily, however, it could also represent stationary or occluded fronts.

3-11. Severe weather such as gusty winds, thunderstorms, and conditions that are right for tornadoes to form.

3-12. The relative humidity of a volume of air is the ratio (in percent) between the water vapor actually present and the water vapor necessary for the saturation at a given temperature.

3-13. The dewpoint is the temperature to which air must be cooled, at constant pressure, and water vapor level, in order for saturation to occur.

3-14. The spread between the dewpoint and temperature. The smaller the spread the more likely fog will form.

3-15. Advection fog.

3-16. Aircraft icing reduces aerodynamic efficiency by decreasing lift and increasing drag. This can reduce the aerodynamic efficiency to such an extent that the aircraft can no longer fly.

3-17. Clear icing.

3-18. (1) Trace, (2) Light, (3) Moderate, and (4) Severe.

3-19. Natural and manmade.

3-20. Clear air turbulence.

3-21. Light, moderate, severe, and extreme.

3-22. It is a rhythmic bumpiness which causes little change in attitude.

3-23. Because they are almost always accompanied by strong gust of wind, severe turbulence, and icing. Also heavy rain and hail are not uncommon.

3-24. (1) Thunderstorm (T); and severe thunderstorm (T+).

3-25. a. (1) Cumulus, (2) Mature, and (3) Dissipating.
b. Mature

3-26. a. Increased "go-around" notification and longer "runway time" for aircraft.
b. Prompt advisories of location; assistance in avoiding the areas; priority handling of traffic affected as necessary.
c. Prompt advisories of location; assistance in avoiding area; priority handling of traffic affected as necessary.

4-1. The National Weather (NWS).

4-2. The Naval Oceanography Command.

4-3. Service A and Service C.

4-4. COMEDS is a network controlled by the Air Force, which is used to collect and disseminate military aviation weather information and pilot reports.

4-5. a. Station designator.
b. Type of report.
c. Time of report.
d. Sky and ceiling.
e. Visibility, weather, and obstructions to vision.
f. Sea level pressure.
g. Temperature and dew point.
h. Wind.
i. Altimeter.
j. Remarks.

4-6. NGU SP 1634 M5 BKN

4-7. 20 SCT E30 BKN 280 BKN

4-8. 3/4 R-SFBS, and in remarks: VSBY 1/2V1. Remember, when encoding weather elements, the order is: liquid, freezing and frozen. Thus, light rain is encoded before moderate snow. The obstructions to vision could be encoded as FBS or BSF. However, assuming that "some blowing snow" indicates less predominance than "fog," we encoded the fog first.

4-9. 2707.

4-10. Wind 110 degrees at 110 knots.

4-11. Indefinite ceiling zero, sky obscured, visibility zero, fog.

4-12. One thousand scattered, estimated ceiling three thousand overcast, visibility five, haze, sea level pressure 1014.1 temperature three eight, dew point two eight, wind 320 degrees estimated at one five knots, altimeter 30.00.

4-13. Runway 18 right, visibility value more than one-quarter.

4-14. Clear, visibility three, ground fog, haze, temperature four zero, dew point three eight, wind two seven zero at four, altimeter two niner niner zero.

4-15. Indefinite ceiling one hundred, sky obscured, visibility one-sixteenth, fog, temperature four three, dewpoint four three, wind calm, altimeter three zero zero zero.

4-16. Sky partially obscured, estimated ceiling seven hundred overcast, visibility three-eights, snow, blowing snow, temperature two niner, dew point two five, wind three two zero at one five peak gust two zero, altimeter two niner eight three.

4-17. Measured ceiling five hundred broken, one thousand five hundred overcast, visibility two, severe thunderstorm, heavy rain showers, temperature four five, dew point four three, wind three four zero at four eight peak gust five five, altimeter two niner eight four.

4-18. One five thousand scattered, visibility one zero, temperature eight niner, dewpoint eight one, wind zero one zero at one zero, altimeter three zero zero three.

4-19. You should solicit PIREPs when requested by ATC, FSS, or WSO and/or when the following conditions exist or are forecast:

a. Ceilings at or below 5,000 feet.
b. Visibility (surface or aloft) at or below 5 miles.
c. Thunderstorms and related phenomena.
d. Turbulence, especially Clear Air Turbulence, of moderate degree or greater.
e. Icing of moderate degree or greater.
f. Wind shear.

4-20. UUA/OV NAS 090015 2228 FL 130/TP T39/ TB LGT/RM HAIL.

4-21. UA/OV JAX 1600 FL UNK/TP C130/RM DISCHARGE.

4-22. UA/OV DCA 270020 1815 FL 090/TP UNK/ WV 160080.

4-23. The visibility is included in FTs and FAs when it is expected to be 6 miles or less. Wind is included in FTs when it is expected to be 10 knots or more, and in FAs when the wind is expected to be 25 knots or more. In FTs the word "WIND" appears in the outlook section if it is expected to exceed 24 knots.

4-24. FTs are valid for 24 hours. The first 18 hours are forecast and the last 6 hours a categorical outlook.

4-25. Area Forecast (FA).

4-26. The Plain Language Terminal Forecast (PLATF) code and format has been adopted by the Naval Oceanography Command and its activities within the U.S. for pilot briefing.

4-27. Navy Norfolk is forecast to be IFR between 1200Z and 2300Z.

4-28. The lowest ceiling and visibility are expected to occur between 1700Z and 1900Z, with a 500 foot ceiling and visibility variable between 1/2 and 1 mile.

4-29. a. AIRMETs will be issued when the following conditions exist or are forecast:

(1) Moderate icing
(2) Moderate turbulence
(3) Areas of visibility less than 3 miles and/or ceiling less than 1,000 feet.
(4) Sustained winds of 30 or more knots within 2,000 feet of the surface.

b. SIGMETs will be issued when the following conditions exist or are forecast:

(1) Tornadoes
(2) Lines of thunderstorms (squall lines)
(3) Embedded thunderstorms
(4) Hail 3/4 inch in diameter or more
(5) Severe and extreme turbulence
(6) Severe icing
(7) Dust or sand storms lowering the visibility to less than 3 miles.

4-30. a. AIRMETs are broadcast by FSS upon receipt and at 30 minute intervals at H+15 and H+45 during their valid period.

b. SIGMETs are broadcast by all ATC facilities upon receipt and by FSS upon receipt and at 15 minute intervals at H+00, H+15, H+30, and H+45 for the first hour after issuance. Thereafter, FSS broadcast SIGMETs at H+15 and H+45 for the remainder of their valid period.

4-31. WWs are issued when (1) severe thunderstorms and/or (2) tornadoes are expected within a particular geographical area.

5-1. 1.

5-2. 1.

5-3. 4.

5-4. 2

5-5. K

5-6. The distance required for takeoff greatly increases on airfields with short runways, jet operations may not be possible.

5-7. Thrust stream turbulence and wingtip vortices.

5-8. The aircraft's weight, wing span, and speed.

5-9. Speeds, rates of climb and descent, and fuel consumption.

5-10. One way is to let the fighter aircraft remain at altitude as long as possible. Another is to not unduly delay its departure or landing.

5-11. Minimum fuel.

6-1. j.

6-2. i.

6-3. c.

6-4. b.

6-5. f, g.

6-6. h.

6-7. g.

6-8. a.

6-9. d, e.

6-10. Variation

6-11. 24; i.e., $360° \div 15° = 24$.

6-12. Greenwich Mean Time (GMT) and/or Zulu time.

6-13. 24

6-14. 1200, noon.

6-15. 090°

6-16. 360°

6-17. a.

6-18. b.

6-19. c.

6-20. (1) DMACC/GADF, (2) DDCP Washington, D.C.

6-21. Philadelphia, Pennsylvania and Clearfield, Utah.

6-22. DD Form 1348m

6-23. (a) DD Form 1348 and SF 344

(b) DD Form 1348m

(c) DD Form 173

(d) SF 344

(e) DD Form 1348m

6-24. DMAAC, St. Louis AFS, Missouri. You may submit requirements by letter or any of the forms above.

6-25. (a) Semiannually

(b) Semiannually

(c) Semiannually

(d) Monthly

(e) Monthly

6-26. (a) F. The semiannual Astronautical Chart Bulletin Digest contains all the updated information from previous Bulletin Digest and monthly Bulletins, and the previous editions of both may be discarded; however, the Bulletins (monthly) are a cumulative system and all monthly Bulletins should be retained until the issuance of a new Bulletin Digest.

(b) T.

6-27. (1) planning, (2) en route, and (3) terminal.

6-28. Homing, holding, and making an approach.

6-29. Range

6-30. An NDB with voice can be used to broadcast routine information (ATIS, for example) and as an emergency transmitter or receiver.

6-31. Reference and variable; phase angle.

6-32. Radio courses: The omnifacility through its unique system of creating "radials" insures that the aircraft remains within a very narrow corridor which leads straight to the omnifacility.

Line of sight transmissions: This means that the omnifacility's radio waves travel a straight line from the facility. In traveling this straight line, the signals are not influenced by the terrain, thereby providing a better, more reliable signal.

Closer locating of omnifacilities: Because of the radio band in which they operate, omnifacilities can be placed closer together. This provides more facilities for position fixing within a given area.

6-33. d and e.

6-34. b and c.

6-35. Reduced separation standards, precise holding patterns, enroute courses which "arc" terminal areas, many easily identified reference points.

6-36. Through the use of DME your control duties are made easier because of the more varied options of control techniques available.

6-37. a. Outer marker beacon; to establish final approach fix.

b. Localizer; ILS course information.

c. Glide slope transmitter; electronic glidepath (slope).

d. Middle marker beacon; to provide an accuracy fix along the approach path.

6-38. a. F; b. T.

6-39. a. T; b. T.

6-40. a. T; b. F.

6-41. a. T; b. T.

6-42. a. F; b. T.

6-43. a. T; b. T.

6-44. 1. (e); 2. (a); 3. (d); 4. (c).

7-1. The main function of the Flight Planning Branch is to provide a facility for the planning and processing of flight plans.

7-2. Flight Planning Branch personnel.

7-3. Air Traffic Control Facilities Manual OPNAV-INST 3721.1.

7-4. To provide pilots with the necessary tools (charts, approach plates, gas chits etc.) to complete a flight.

7-5. The pilot in command.

7-6. DD Form 175 Military Flight Plan.

7-7. DD Form 175-1 Flight Weather Briefing Form.

7-8. All flight planning and daily flight schedules forms must be kept on file for 3 months.

7-9. a. VIP, Rear Admiral, accord honors.
b. Require servicing, will discharge 8000 pounds of cargo and can accept 5000 pounds of cargo, need transportation for 16 people and quarters for three male officers and 11 male and 2 female personnel, will RON one night.
c. None.

7-10. Flight Service Stations (FSS).

7-11. Service F.

7-12. Utility B.

7-13.

Departures	Arrivals
1. f.	1. f.
3. g.	3. g.
5. d.	5. d.
6. e.	6. h.
7. c.	7. b.
8. a.	8. i.

7-14. 1. d.
2. f.
3. b.
4. e.

7-15. (a) X
(b) U, A, P, and R

7-16. a. A PD
b. V < 1430
c. 50/1430↑90 or $\frac{50\uparrow 90}{1430}$

7-17. One hour before ETA.

7-18. 30 minutes after actual departure time (ATD).

7-19. 1. c
2. e
3. c
4. a

7-20. The U.S. Air Force and the U.S. Coast Guard.

7-21. QALQ

7-22. (a) INREQ, (b) ALNOT

7-23. 1200—ETA

1230—Aircraft is overdue, conduct communications search, then send QALQ to departure station.

1300—Issue INREQ

1400—Unless negative replies to INREQ received earlier, issue ALNOT

1500—Unless negative replies to ALNOT is received earlier, transfer search to RCC

? —When aircraft is located or RCC suspends the search, cancel the ALNOT

7-24. An IFR aircraft is considered overdue when neither radio communications nor radar contact can be established with it and 30 minutes have elapsed since an ETA over a specified or compulsory reporting point on clearance limit. At this time the appropriate ARTCC must alert RCC and issue an ALNOT.

7-25. Under any of the following conditions, transfer the responsibility for further search of an overdue aircraft to the RCC:

1. When 30 minutes have elapsed after the estimated fuel exhaustion time.
2. When the aircraft has not been found within one hour after issuing the ALNOT.
3. When the ALNOT search has been completed with negative results.

7-26. USAF Central NOTAM Facility (AFCNF).

7-27. Naval Flight Information Group (NAVFIG).

7-28. Ultimately, the Commanding Officer is responsible for the promulgation and posting of NOTAMs. However, Navy ACs or civilian personnel employed as a flight dispatcher actually perform NOTAM duties.

7-29. The NAMSUM is transmitted Sunday through Friday at 1630Z and is updated hourly with a cumulative listing of changes to the current summary.

7-30. (a) NOTAM
KNGU
N 301115 NORFOLK NAS
TACAN OUT

(b) NOTAM
KNGU
C301115 NORFOLK NAS
TACAN IN

(c) NOTAM
KNIP
N 200604 JACKSONVILLE NAS
FIELD CLOSED 221600/221930
JUN

8-1. Adequate area, accessibility, prevailing weather conditions, and terrain.

8-2. The direction of the maximum wind coverage (prevailing wind).

8-3. Field elevation, mean maximum temperature, and the principal types of aircraft that will operate from the field.

8-4. Every 15 degrees beginning with magnetic north.

8-5. 10L and 28R

8-6. i

8-7. d

8-8. g

8-9. a

8-10. h

8-11. e

8-12. a

8-13. c

8-14. e and f, two each

8-15. The control tower.

8-16. The military airport's rotating beacon has a split (two flashes) white light alternating with a green light. Civil airport beacons display alternating (single) white and green flashes.

8-17. Yes, because the visibility is 2 miles, it is required that the approach lights be on.

8-18. On. While the ceiling does not meet the requirements, the visibility does; therefore, the lights should be on.

8-19. On. Again because of the visibility.

8-20. Off. During the period sunrise to sunset, the beacon is off, except when the airport is below VFR.

8-21. 1. Wind tee, 2. tetrahedron, and 3. wind so

8-22. (a) Flashing lights on the tetrahedron;
(b) activating the airport rotating beacon

8-23. The station's Air Operations manual

8-24. AN/GRC-100.

8-25. At least 30 minutes before the severe w anticipated.

8-26. The secondary crash alarm system phone).

8-27. The Emergency Radio Communicatio tems.

8-28. (a) The crash network;
(b) the internal security network

8-29. 1. control tower
2. crash/rescue alarm room
3. air operations dispatcher
4. structural fire alarm room
5. air ops duty officer
6. station dispensary or hospital

8-30. Areas 5 F and G.

8-31. E-5 chain gear

8-32. E-28 rotary hydraulic system.

9-1. GCA, tower, RATCF, base operations, and weather station.

9-2. Service F.

9-3. (1) Emergency messages
(2) control messages
(3) movement messages on IFR traffic
(4) VFR traffic movement messages

9-4. (1) The amended clearance
(2) progress report on IFR traffic
(3) the IFR arrival report

9-5. Voice call: "Cleveland Center, Patterson Tower, Arrival."

9-6. The initials of the Grissom tower controller which indicates he has completed his message.

9-7. All receivers must be checked for proper operation at least once each watch. This normally done by the oncoming watch upon releaving the offgoing watch.

9-8. 1. Obscene or profane language.
2. False or deceptive communications.
3. A facility identification not authorized or assigned.
4. Malicious or interfering communications.
5. Superfluous remarks including those of a personal nature.
6. Any classified information.

9-9. Transmissions which pertain safety of flight or preservation of life, official FAA messages, and on a limited basis, operational and tactical messages.

9-10. Final approach, touch down, landing roll, take-off, and initial climb to the first turn away from the airfield are considered to be the most critical phases of flight.

9-11. Because anyone with the minimum of equipment can intercept such communications.

9-12. EMCON

9-13. SCATANA

9-14. 1. d
2. c
3. e

9-15. In transferring communications state to the pilot:

(1) Location of the facility to contact.
(2) Frequency to use.
(3) When, where, etc., if the transfer isn't to be immediately.

9-16. In replying to a call-up, state:

(1) The identification of the aircraft calling.
(2) Your facility's identification.
(3) The word "over".

9-17. "Skip two-one, whiting tower, over."

9-18. That it be clear and understandable the first time it is received.

9-19. It avoids misinterpretation because everyone is speaking the same language and using various words and phrases with pre-agreed upon meanings.

9-20. They reflect indecision.

9-21. The habit of increasing the rate of speech and control instructions as the traffic gets closer to the runway.

9-22. It would be desirable only on occasions requiring its use, otherwise, undesirable.

9-23. 1. Loud and clear
2. loud and garbled
3. weak but clear
4. weak and garbled
5. unreadable

9-24. 1. a
2. e
3. g
4. i
5. f
6. d
7. c

9-25. column A

b 1. OUT

d 2. WILCO

e 3. ROGER

g 4. OVER

h 5. STANDBY

9-26. Generally, all operating positions which provide ATC services are recorded on separate channels. Additionally, VHF, UHF, primary local control, and primary approach control frequencies are recorded on separate channels.

9-27. Naturally, maintenance personnel should repair the equipment. However, you as controller, must use flight data strips to record all clearances and control instructions issued.

9-28. 15 days

9-29. OPNAVINST 3721.1

9-30. By the pilot acknowledging that he has received the ATIS broadcast, and you comparing his response to what you know is the latest broadcast.

9-31. Issue all pertinent information

9-32. Automatic Terminal Information Service. It is a continuous broadcast of noncontrol information using the voice facilities of a local NAVAID.

9-33. Yes. It eliminates the need for you to continually repeat routine information, thereby making more time available for control instruction.

10-1. A green light will glow above the selected switch.

10-2. (a) 20 (b) 23

10-3. (a) speaker amplifier
(b) console amplifier
(c) radiophone TX/RX
(d) interphone TX/RX modules

10-4. That frequency is in use by another controller.

10-5. There are no limitations as to the number of channels available. Additional modules are added as needed.

10-6. (1) circuit discipline
(2) aircraft accident analysis
(3) voice training of ATC personnel

10-7. Ten; however, one channel is usually used to produce a time display.

10-8. You must enter all flight clearance and control data on the appropriate flight process strip.

10-9. (a) plus or minus 4 degrees or 4 knots
(b) plus or minus 9 degrees or 9 knots

10-10. No action is required; however, if the error is from .02 to .03 inches, the maintenance personnel must be notified and the correction factor is added to or subtracted from the indicated value. If the difference equals or exceeds .04 inches, the altimeter indicator is considered inoperative.

10-11. First, give several alternating red and green lights, followed by a flashing green.

10-12. Flashing red

10-13. 10 miles day and 15 miles night.

10-14. Only when the tower has experienced a radio outage.

10-15. The GSA-35 serves as a NAVAID monitor which can monitor the status of a TACAN, VOR, and UHF Homer. It provides both a visual and aural alarm should failure occur at the transmitter sight and a means to dial up the standby transmitters or to shut down or restore any, or all, of the transmitters at the transmitter locations.

10-16. 100, 1600 feet.

10-17. The five basic components of the BRITE-2 system are: (1) TV display unit, (2) remote control panel, (3) the planned position indicator (PPI), (4) TV camera, and (5) maintenance control panel.

10-18. The BRITE-2 system may be used to correlate visual observations, assist in sequencing traffic, aid in providing traffic advisories, vector aircraft under limited conditions, and apply radar separation.

10-19. It indicates that an aircraft has entered the radar ATC system and is receiving radar service.

10-20. It indicates an aircraft has reached a point on final approach which is 7 miles from touchdown, or the end of the runway, and the final controller is requesting clearance to continue the approach to at least 3 miles.

10-21. An aircraft under radar control has been cleared to land, make a touch-and-go, low approach, or stop and go.

10-22. That for some reason the tower local controller wants the final controller to discontinue the approach of the aircraft under radar control.

10-23. AP

10-24. LC

10-25. GC

10-26. FD

10-27. 1. pertinent field information

2. bird activity information

3. weather

4. runway condition information

10-28. When the wind speed is less than 5 knots provided there is no "runway use" program in effect.

10-29. The final approach, touch down, landing roll, takeoff, and initial climb phases.

10-30. When clear of the landing runway

10-31. First come first serve.

10-32. Overhead approach pattern (BREAK)

10-33. Standard rectangular or conventional patterns.

10-34. A clearance to land.

10-35. A request to report on initial approach.

10-36. You give the pilot his number in the traffic pattern in respect to the number of other aircraft ahead of him, and a description of the aircraft he is to follow and where this aircraft is.

10-37. You can direct the pilot to: "Extend Downwind, Make Short Approach, Circle the Airport, Go Around, Break at Mid Field or Break at the Departure End of the Runway," just to name a few.

10-38. Since a category III aircraft is involved, the runway must be clear before the category II crosses the landing threshold.

10-39. In this case, the category of the aircraft involved is NOT a factor because they are NOT using the same runway. Therefore, one of the following needs to occur before the arriving aircraft crosses the landing threshold: (1) the departure must have crossed the intersection, or (2) must be airborne and turning to avoid any conflict.

10-40. The departure need only be airborne and a minimum of 6000 feet from the threshold before the arriving aircraft crosses the threshold.

10-41. The touch-and-go aircraft must be airborne and have traversed a minimum of 3000 feet before the arriving category I aircraft crosses the landing threshold.

10-42. The category I aircraft must be airborne and have traversed at least 4500 feet before the succeeding category II aircraft begins takeoff roll.

10-43. You must ensure that the category II aircraft does not begin takeoff roll until at least three minutes after the category III aircraft has taken off, unless the pilot initiates a request to deviate from the three minute interval.

10-44. If there is reasonable assurance that the required separation will exist before the departure begins takeoff roll, you may clear a departure for takeoff, with appropriate traffic information, after the low approach passes the warmup position. The departure must be held short of the runway until the low approach crosses the takeoff position. In this situation, the low approach aircraft must have crossed a point at least 4500 feet from the landing threshold before the departure begins takeoff roll.

10-45. The first helicopter must have either come to a full stop or taxied clear of the helipad.

10-46. 300 feet

10-47. The departing category III aircraft must be airborne and have traversed at least 6000 feet before the arriving category I aircraft crosses the runway threshold. In this situation, we must use same runway separation standards because the distance between the runway centerlines does not meet the minimum required, to allow simultaneous operations when category III aircraft are involved. The time of operation (sunset to sunrise) is not a factor unless both aircraft are arriving.

10-48. The only information, other than items pertaining to hazardous conditions, issued by the tower are initial taxi and takeoff instructions.

11-1. FAA

11-2. All altitudes from 1,200 above the surface, up to but not including 18,000 MSL.

11-3. IFR ATC service is provided within all controlled airspace.

11-4. The separation of aircraft.

11-5. First come, first serve

11-6. Only after it is in your area of jurisdiction unless specifically coordinated or as specified by letter of agreement.

11-7. The transferring controller must eliminate any potential conflict with other aircraft under his or her jurisdiction prior to transferring control responsibility. In addition, the transferring controller must coordinate with the receiving controller so as to transfer control at a specified time, fix, or altitude.

11-8. Prior to the aircraft entering the receiving controller's area.

11-9. ATC clears . . .

11-10. Because the time and source of the altimeter were not given.

11-11. (3)

11-12. (1)

11-13. Not later than 5 minutes after the aircraft was estimated over the fix.

11-14. No traffic suspension period is required when radar separation is applied.

11-15. 1040. Since the airspeed of AG01 is unknown, and we are dealing with a time separation, 10 minutes is applicable standard.

11-16. 10-mile arc or the 30-mile arc.

11-17. 10 miles, as both aircraft are using DME, both are using the same fix, and the first aircraft is more than 22 knots faster than the following aircraft.

11-18. 10 minutes

11-19. 10 miles

11-20. 3 minutes after each report passing the same fix.

11-21. 30°

11-22. 3 minutes

11-23. 5 miles

11-24. When the departure will fly courses which diverge by 45° or more immediately after takeoff.

11-25. Time and/or distance.

11-26. At one of two points: (1) if the arrival has reported a fix inbound located not less than 4 miles from the runway, or (2) in the absence of such a fix, the ETA of the arrival is less than 3 minutes away.

11-27. No. Since there is no fix to positively establish the distance of aircraft B, and the takeoff direction is not separated from the inbound heading by 45° or more, than 5 minutes or more separation is required before aircraft B is estimated to reach the airports.

11-28. (1) the controller sees the aircraft in question and can provide visual separation.
(2) the pilots see each other and state that they will maintain visual separation.

11-29. The weather must be at or above basic VFR minimum.

11-30. (1) when pilot reports indicate that the weather conditions are not suitable for such operations.
(2) between sunset and sunrise to separate holding aircraft from each other or en route aircraft unless restrictions are applied to ensure appropriate IFR vertical separation.

11-31. No IFR ATC separations are provided in this case.

11-32. Ground visibility of 1 mile and clear of clouds.

11-33. SVFR CONDITIONS AT OR BELOW THREE THOUSAND FIVE HUNDRED.

11-34. Inform the arriving aircraft that the ground visibility is less than one mile and that, unless an emergency exists, a SVFR clearance can not be issued.

11-35. Ask the pilot if he has a flight visibility of at least one mile. If the pilot's reply is yes, request a SVFR clearance and relay it to the pilot. If the pilot's answer is NO, inform the pilot that a clearance cannot be issued unless an emergency exists.

11-36. 2 miles

11-37. 2 miles

12-1. As explained in the text, radar operates on the "echo" principle. Some of the energy sent out by the antenna is reflected (echoed) back by the reflecting object and received by the antenna.

12-2. The "duplexer" enables the system to use the same antenna for transmitting and receiving.

12-3. The "synchronizer," as the name implies, is the component which "times" the functions of the system and thereby insures that everything occurs at the prescribed moment.

12-4. The "CRT," like a television screen, is where the results of all the electronic operations are displayed for you to interpret.

12-5. The three general hazards discussed in the text are (1) electrical shock, (2) electromagnetic radiation, and (3) the potential hazard from radioactivity should a CRT be broken.

12-6. For electrical shock, do not adjust equipment items not meant to be controller items—leave maintenance to maintenance people; for electromagnetic radiation, do not subject yourself to prolonged exposure from antennas which are radiating a signal; and, for radioactivity, do not hit or otherwise damage the face of CRTs as this could result in the tube breaking and your being cut by glass and exposure to radioactive material.

12-7. The effect, which is automatic, is to cancel returns which are stationary, while receiving and displaying moving returns. However, this action is combined with normal video; so, instead of being all encompassing as with straight MTI, it is a mixture of both occurring at random places throughout the sweep.

12-8. STC prevents close-in targets from blooming while distant targets appear weak.

12-9. It eliminates all but the very heaviest precipitation areas occurring within range of the radar from being displayed on the scope face.

12-10. Video mapper.

12-11. Radar beacon equipment.

12-12. 1. Target fades
2. Anomalous propagation
3. False targets
4. Jamming
5. Electronic interference

12-13. 1. Reinforced radar targets
2. Rapid target identification
3. Extended area of coverage
4. Altitude, emergency, and other data displayed on scope

12-14. Secondary radar is not effected by the size of aircraft reflection areas, precipitation, ground clutter, or blind spots in the antenna coverage pattern.

12-15. (a) interrogator
(b) transponder

12-16. (1) 3/A
(2) C
(3) 1 and 2

12-17. 4,096 codes

12-18. TPX-42 (series)

12-19. (1) 7700
(2) 7600

12-20. F

12-21. T

12-22. T

12-23. T

12-24. F

12-25. F

12-26. F

12-27. T

12-28. T

12-29. F

13-1. e.

13-2. g.

13-3. f.

13-4. a.

13-5. d, f, or h.

13-6. c.

13-7. Initial identification; reidentification.

13-8. Turns for identification; secondary radar beacon procedures.

13-9. Is not.

13-10. No. This is only partial contact. You must also have the pilot tell you the aircraft's heading or route of flight, and it must coincide with the heading or route of flight of the aircraft you are tracking. Then it is radar contact.

13-11. Direction of turn; the magnetic heading to be flown after the turn.

13-12. That he will be vectored across the final approach course and the reason.

13-13. When the vector is to avoid traffic and the aircraft is outside your area of control jurisdiction.

13-14. "Turn (degrees) (left/right)."

13-15. True. If you are satisfied of the aircraft's identity.

13-16. False. The aircraft's identification should be given first.

13-17. True.

13-18. False.

13-19. When the arriving IFR aircraft will be vectored off the nonradar route and the pilot will likely encounter IFR weather conditions.

13-20. If the ceiling is reported below 1000 feet or below the highest circling minimum, whichever is greater, or the visibility is less than 3 miles.

13-21. General and detailed.

13-22. Detailed holding instructions always include leg length and direction of turns.

13-23. A time check and an EFC.

13-24. 5 minutes.

13-25. 5 miles.

13-26. Yes. In this instance, 1 1/2 miles is the minimum standard.

13-27. Within 40 miles, it is 3 miles. It is unlikely that you would ever vector an aircraft at ranges beyond 40 miles at altitudes low enough to see permanent echoes, since few search radars scan below about 4000 feet at 40 miles; therefore, vertical separation is mainly employed outside of 40 miles.

13-28. The minimum standards are: heavy category aircraft following another heavy category aircraft is 4 miles; whereas a nonheavy category following a heavy category is 5 miles.

13-29. 10 to 30 seconds prior to aircraft intercepting the glidepath.

13-30. Control instructions—no. You do continue to provide advisory information in the form of trend information.

13-31. Tell the pilot to take over visually, if able; if not, to execute a missed approach.

13-32. You should tell him that he is at the missed approach point, and, if the runway or approach lights are not in sight, to execute a missed approach.

13-33. Two differences. One is in the approach information provided the pilot which is the instruction to "circle to runway (number)"; the other, the fact that the circling MDA controls the minimums for the approach.

13-34. The aircraft is vectored to the VFR traffic pattern, and should be released to contact the tower in time for the local controller to sequence the aircraft with other traffic normally at least 5 miles from the airport.

13-35. A ceiling at least 500 feet above the minimum radar vectoring altitude and a visibility of at least 3 miles.

13-36. Observing the aircraft within 1 mile of the departure end of the runway.

13-37. When you intend to vector the aircraft immediately after takeoff.

13-38. Yes, if accomplished within 40 miles of the antenna site and proper separation from obstructions is provided.

13-39. 2 miles.

13-40. Stage II radar service provides for sequencing of VFR, whereas Stage I does not.

13-41. Stage III radar service provides for maximum use of the terminal radar. Through this service, all IFR and most all VFR aircraft receive vectoring, sequencing, separation, and traffic information upon arrival in the terminal area.

13-42. Azimuth of the traffic from the aircraft's position, distance, and direction of movement. If known, aircraft type and altitude.

13-43. No. However, as was pointed out, you should endeavor to provide as many as possible without neglecting your primary obligations.

13-44. Vectoring aircraft to avoid target merging is a true additional service. The priority of duties gives first priority to the separation of aircraft, second priority to services that are required but do not involve separation, and the last priority to duties classified as additional.

13-45. Inform the pilot of the minimum safe altitude.

13-46. First, find out if the pilot is IFR rated and capable of IFR flight.

13-47. You would request the emergency information items listed in the text, then, applying the radar assistance techniques discussed, vector the aircraft to an area of VFR weather or to the airport for an approach. Remember that in this particular incident, the aircraft is lost.

13-48. 7500.

13-49. First, you should find out if the pilot intended to "squawk" 7500. Based on the reply, either have him recycle the transponder to the appropriate code or notify your supervisor, continue normal handling of the aircraft, and provide what other assistance the moment requires.

13-50. He should adjust his transponder to reply on code 7700 for a period of one minute and then change to code 7500 for 15 minutes.

13-51. It should tell you that the pilot has lost some or all of the aircraft's communications ability.

13-52. You should state, "Reply not received; if you hear me (have the pilot turn the aircraft to a specific heading, ident, etc.)."

14-1. D

14-2. B

14-3. A

14-4. C

14-5. B

14-6. D

14-7. A

14-8. Air Operations (Air Ops) and Carrier Controlled Approach (CCA).

14-9. Air Ops.

14-10. Air Ops.

14-11. Teletype operator.

14-12. DRT operator.

14-13. CCA.

14-14. Approach controller and final controller.

14-15. Departure controller.

14-16. "99 (collective call sign)" followed by the message.

14-17. 1 1/2 hr.

14-18. Closed Circuit Television (CCTV).

14-19. Flights which will penetrate controlled airspace, ADIZ boundaries, or terminate at shore activities.

14-20. The Air Operations officer.

14-21. Close, advisory, and monitor control.

14-22. Close control.

14-23. Monitor control.

14-24. (a) 3 miles
(b) 5 miles
(c) 2 miles

14-25. 800 feet.

14-26. 500 feet.

14-27. 20°.

14-28. Case I departures are appropriate when flights will not encounter IMC and the weather at the ship is at least 3,000 feet and 5 miles.

14-29. Case II departures are appropriate when weather conditions at the ship exist down to a ceiling of 1,000 feet and a visibility of 5 miles.

14-30. Case III.

14-31. 25 miles.

14-32. 39 mile DME on the 180 radial.

14-33. 2,000 feet.

14-34. Overhead marshall.

14-35. Case III recoveries must be used when the weather at the ship is below 1000 feet and 3 mile, and during all flight operations conducted between 1/2 hour after sunset and 1/2 hour before sunrise.

14-36. 200:1/2.

14-37. When the aircraft is within 10 miles of the ship and has reported the ship in sight.

14-38. Case III.

14-39. Continue descent to 600 feet and continue approach until the LSO assumes control.

14-40. 1200 feet and 150 knot.

14-41. Mode I.

14-42. Mode 2T.

14-43. CATCC/DAIR

14-44. Prior to reaching a point 1 1/2 miles from the carrier.

14-45. When the pilot transmits "BALL" and is prepared to complete the approach visually.

14-46. SPN-42.

14-47. SPN-41.

14-48. The FLOLS is a lens system used to provide the pilot with a visual indication of his relative position with respect to the prescribed glide slope.

14-49. Four.

14-50. The PLAT system provides an instant picture of all landings/launches plus tape recordings for future replays. The recordings are used as debriefing material and help to avoid/correct human errors.

APPENDIX B

GLOSSARY

This glossary includes terms which are intended for pilot/controller communications. Those terms most frequently used in pilot/controller communications are printed in boldface. For your convenience, there are also cross references to related terms in other parts of the Glossary and to other documents, such as the Federal Aviation Regulations (FARs) which can be found in Appendix D of this manual.

abeam—An aircraft is "abeam" a fix, point, or object when that fix, point, or object is approximately 90° to the right or left of the aircraft track. Abeam indicates a general position rather than a precise point.

abort—To terminate a preplanned aircraft maneuver, e.g., an aborted takeoff.

acknowledge—Let me know that you have received and understand my message.

ACROBATIC FLIGHT—An intentional maneuver involving an abrupt change in an aircraft's attitude; an abnormal attitude or abnormal acceleration not necessary for normal flight. (Refer to FAR Part 91.)

ADDITIONAL SERVICES—Advisory information provided by ATC, which includes but is not limited to the following:

1. Traffic advisories.
2. Vectors, when requested by the pilot, to assist aircraft receiving traffic advisories to avoid observed traffic.
3. Altitude deviation information of 300 feet or more from an assigned altitude, as observed on a verified (reading correctly) automatic altitude readout (Mode C).
4. Advisories that traffic is no longer a factor.
5. Weather and chaff information.
6. Weather assistance.
7. Bird activity information.
8. Holding pattern surveillance.

Additional services are provided to the extent possible, contingent only upon the controller's capability to fit them into the performance of higher priority duties, and on the basis of limitations of the radar, volume of traffic, frequency congestion, and controller workload. The controller has complete discretion for determining if he is able to provide or to continue to provide a service in a particular case. The controller's reason not to provide or continue to provide a service in a particular case is not subject to question by the pilot and need not be made known to him. (See Traffic Advisories.)

ADMINISTRATOR—(Refer to Appendix D, FAR Part 1.)

advise intentions—Tell me what you plan to do.

ADVISORY— Advice and information provided to assist pilots in the safe conduct of flight and aircraft movement. (See Advisory Service.)

ADVISORY FREQUENCY—The appropriate frequency to be used for Airport Advisory Service. (See Airport Advisory Service; UNICOM.)

ADVISORY SERVICE—Advice and information provided by a facility to assist pilots in the safe conduct of flight and aircraft movement. (See Airport Advisory Service; Traffic Advisories; Safety Advisories; Additional Services; Radar Advisory; En Route Flight Advisory Service.)

AERIAL REFUELING/IN-FLIGHT REFUELING—A procedure used by the military, to transfer fuel from one aircraft to another during flight.

AERONAUTICAL BEACON—A visual NAVAID displaying flashes of white and/or colored light to indicate the location of an airport, a heliport, a landmark, a certain point of a Federal airway in mountainous terrain, or a hazard. (See Airport Rotating Beacon.)

AERONAUTICAL CHART—A map used in air navigation, containing all or part of the following: topographic features, hazards and obstructions, navigation aids, navigation routes, designated airspace, and airports. Commonly used aeronautical charts are:

1. Sectional Charts—1:500,000—Designed for visual navigation of slow- or medium-speed aircraft. Topographic information on these charts features the portrayal of relief and a judicious selection of visual checkpoints for VFR flight. Aeronautical information includes visual and radio aids to navigation, airports, controlled airspace, restricted areas, obstructions, and related data.

2. VFR Terminal Area Charts—1:250,000—Depict Terminal Control Area (TCA) airspace which provides for the control or segregation of all the aircraft within the TCA. The chart depicts topographic information and aeronautical information which includes visual and radio aids to navigation, airports, controlled airspace, restricted areas, obstructions, and related data.

3. World Aeronautical Charts (WAC)—1:1,000,000—Provide a standard series of aeronautical charts covering land areas of the world, at a size and scale convenient for navigation by moderate speed aircraft. Topographic information includes cities and towns, principal roads, railroads, distinctive landmarks, drainage, and relief. Aeronautical information includes visual and radio aids to navigation, airports, airways, restricted areas, obstructions, and other pertinent data.

4. En Route Low-Altitude Charts—Provide aeronautical information for en route instrument navigation (IFR) in the low-altitude stratum. Information includes the portrayal of airways, limits of controlled airspace, position identification and frequencies of radio aids, selected airports, minimum en route and minimum obstruction clearance altitudes, airway distances, reporting points, restricted areas, and related data. Area charts which are a part of this series furnish terminal data at a large scale in congested areas.

5. En Route High-Altitude Charts—Provide aeronautical information for en route instrument navigation (IFR) in the high-altitude stratum. Information includes the portrayal of jet routes, identification and frequencies of radio aids, selected airports, distances, time zones, special use airspace, and related information.

6. Instrument Approach Procedure (IAP) Charts—Portray the aeronautical data which is required to execute an instrument approach to an airport. These charts depict the procedures, including all related data, and the airport diagram. Each procedure is designated for use with a specific type of electronic navigation system including NDB, TACAN, VOR, ILS, and RNAV. These charts are identified by the type of navigational aid(s) which provide final approach guidance.

7. Standard Instrument Departure (SID) Charts—Designed to expedite clearance delivery and to facilitate transition between takeoff and en route operations. Each SID procedure is presented as a separate chart and may serve a single airport or more than one airport in a given geographical location.

8. Standard Terminal Arrival (STAR) Charts—Designed to expedite air traffic control arrival route procedures and to facilitate transition between en route and instrument approach operations. Each STAR procedure is presented as a separate chart and may serve a single airport or more than one airport in a given geographical location.

9. Airport Taxi Charts—Designed to expedite the efficient and safe flow of ground traffic at an airport. These charts are identified by the official airport name, e.g., Washington National Airport.

affirmative—Yes.

AIRCRAFT—Device(s) that is/are used or intended to be used for flight in the air, and when used in air traffic control terminology may include the flight crew.

ICAO—AIRCRAFT—Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the Earth's surface.

AIRCRAFT APPROACH CATEGORY—A grouping of aircraft based on a speed of 1.3 times the stall speed in the landing configuration at maximum gross landing weight. An aircraft shall fit in only one category. If it is necessary to maneuver at speeds in excess of the upper limit of a speed range for a category, the minimums for the next higher category should be used. For example, an aircraft which falls in Category A but is circling to land at a speed in excess of 91 knots, should use the approach Category B minimums when circling to land. The categories are as follows:

1. Category A—Speed less than 91 knots.
2. Category B—Speed 91 knots or more, but less than 121 knots.
3. Category C—Speed 121 knots or more, but less than 141 knots.
4. Category D—Speed 141 knots or more, but less than 166 knots.
5. Category E—Speed 166 knots or more.

AIRCRAFT CLASSES—For the purposes of Wake Turbulence Separation Minima, ATC classifies aircraft as Heavy, Large, and Small as follows:

1. Heavy—Aircraft capable of takeoff weights of 300,000 pounds or more, whether or not they are operating at this weight during a particular phase of flight.

2. Large—Aircraft of more than 12,500 pounds maximum certified takeoff weight, up to 300,000 pounds.

3. Small—Aircraft of 12,500 pounds or less, maximum certified takeoff weight.

AIR DEFENSE EMERGENCY—A military emergency condition declared by a designated authority. This condition exists when an attack upon the continental U.S., Alaska, Canada, or U.S. installations in Greenland, by hostile aircraft or missiles, is considered probable, is imminent, or is taking place.

AIR DEFENSE IDENTIFICATION ZONE (ADIZ)—The area of airspace over land or water, extending upward from the surface, within which the ready identification, the location, and the control of aircraft are required in the interest of national security.

1. Domestic Air Defense Identification Zone—An ADIZ within the United States, along an international boundary of the United States.

2. Coastal Air Defense Identification Zone—An ADIZ over the coastal waters of the United States.

3. Distant Early Warning Identification Zone (DEWIZ)—An ADIZ over the coastal waters of the State of Alaska.

ADIZ locations, and operating and flight plan requirements for civil aircraft operations are specified in FAR Part 99.

AIRMAN'S INFORMATION MANUAL (AIM)—A publication containing Basic Flight Information and ATC Procedures, designed primarily as a pilot's instructional manual for use in the National Airspace System of the United States.

AIRMAN'S METEOROLOGICAL (AIRMET) INFORMATION—In-flight weather advisories which amend the area forecast. They cover weather phenomena which are of operational interest to all aircraft. These phenomena are potentially hazardous to aircraft having limited capability because of lack of equipment, instrumentation, or pilot qualifications. AIRMETs concern weather of less severity than that covered by SIGMETs or Convective SIGMETs. AIRMETs cover moderate icing, moderate turbulence, sustained winds of 30 knots or more at the surface, widespread areas of ceilings less than 1,000 feet and/or visibility less than 3 miles, and extensive mountain obscurement. (See SIGMET; Convective SIGMET.)

AIR NAVIGATION FACILITY—Any facility used in, available for use in, or designed for use in, aid of air navigation, including landing areas; lights; any apparatus or equipment for disseminating weather information, for signaling, for radio directional finding, or for radio or other electrical communication; and any other structure or mechanism having a similar purpose for guiding or controlling flight in the air or the landing and take-off of aircraft. (See Navigation Aid.)

AIRPORT—(Refer to Appendix D, FAR Part 1.)

AIRPORT ADVISORY AREA.—The area within 10 miles of an airport without a control tower or where the tower is not in operation and on which a flight service station is located. (See Airport Advisory Service.)

AIRPORT ADVISORY SERVICE (AAS)—A service provided by Flight Service Stations at airports not served by a control tower. This service consists of providing information to arriving and departing aircraft concerning wind direction and speed, favored runway, altimeter setting, pertinent known traffic, pertinent known field conditions, airport taxi routes and traffic patterns, and authorized instrument approach procedures. This information is advisory in nature and does not constitute an ATC clearance. (See Airport Advisory Area.)

AIRPORT ELEVATION/FIELD ELEVATION—The highest point of an airport's usable runways, measured in feet from mean sea level. (See Touchdown Zone Elevation.)

AIRPORT/FACILITY DIRECTORY—A publication designed primarily as a pilot's operational manual, containing all airports, seaplane bases and heliports open to the public, including communications data, navigational facilities, and certain special notices and procedures. This publication is issued in seven volumes according to geographical area.

AIRPORT LIGHTING—Various lighting aids that may be installed on an airport. Types of airport lighting include:

1. Approach Light System (ALS)—An airport lighting facility which provides visual guidance to

landing aircraft by radiating light beams in a directional pattern by which the pilot aligns the aircraft with the extended centerline of the runway on final approach for landing. Condenser-Discharge Sequential Flashing Lights/Sequenced Flashing Lights may be installed in conjunction with the ALS at some airports.

Types of Approach Light Systems are:

a. ALSF-I—Approach Light System with Sequenced Flashing Lights in ILS Cat-I configuration.
b. ALSF-II—Approach Light System with Sequenced Flashing Lights in ILS Cat-II configuration.
c. SSALF—Simplified Short Approach Light System with Sequenced Flashing Lights.
d. SSALR—Simplified Short Approach Light System with Runway Alignment Indicator Lights.
e. MALSF—Medium Intensity Approach Light System with Sequenced Flashing Lights.
f. MALSR—Medium Intensity Approach Light System with Runway Alignment Indicator Lights.
g. LDIN—Sequenced Flashing Lead-in Lights.
h. RAIL—Runway Alignment Indicator Lights (Sequenced Flashing Lights which are installed only in combination with other light systems).

2. Runway Lights/Runway Edge Lights—Lights having a prescribed angle of emission used to define the lateral limits of a runway. Runway lights are uniformly spaced at intervals of approximately 200 feet—the intensity may be controlled or preset.

3. Touchdown Zone Lighting—Two rows of transverse light bars located symmetrically about the runway centerline, normally at 100-foot intervals. The basic system extends 3,000 feet along the runway.

4. Runway Centerline Lighting—Flashing centerline lights spaced at 50-foot intervals, beginning 75 feet from the landing threshold and extending to within 75 feet of the opposite end of the runway.

5. Threshold Lights—Fixed green lights arranged symmetrically left and right of the runway centerline, identifying the runway threshold.

6. Runway End Identifier Lights (REIL)—Two synchronized flashing lights, one on each side of the runway threshold, which provide rapid and positive identification of the approach end of a particular runway.

7. Visual Approach Slope Indicator (VASI)—An airport lighting facility providing vertical visual approach slope guidance to aircraft during approach to landing, by radiating a directional pattern of high-intensity, red and white, focused light beams which indicate to the pilot that he is "on path" if he sees red/white; "above path" if white/white; and "below path" if red/red. Some airports serving large aircraft have three-bar VASIs which provide two visual glide paths to the same runway.

8. Boundary Lights—Lights defining the perimeter of an airport or landing area.

AIRPORT ROTATING BEACON—A visual NAVAID operated at many airports. At civil airports, alternating white and green flashes indicate the location of the airport. At military airports, the beacons flash alternately white and green, but are differentiated from civil beacons by dual-peaked (two quick) white flashes between the green flashes. (See Special VFR Operations; Instrument Flight Rules.)

AIRPORT SURFACE DETECTION EQUIPMENT (ASDE)—Radar equipment specifically designed to detect all principal features on the surface of an airport, including aircraft and vehicular traffic, and to present the entire image on a radar indicator console in the control tower. Used to augment visual observation by tower personnel of aircraft and/or vehicular movements on runways and taxiways.

AIRPORT SURVEILLANCE RADAR (ASR)—Approach control radar used to detect and display an aircraft's position in the terminal area. ASR provides range and azimuth information but does not provide elevation data. Coverage of the ASR can extend up to 60 miles.

AIRPORT TRAFFIC AREA—Unless otherwise specifically designated in FAR Part 93, that airspace within a horizontal radius of 5 statute miles from the geographical center of any airport at which a control tower is operating, extending from the surface up to, but not including, an altitude of 3,000 feet above the elevation of the airport. Unless otherwise authorized or required by ATC, no person may operate an aircraft within an airport traffic area except for the purpose of landing at or taking off from an airport within that area. ATC authorizations may be given as individual approval of specific operations or may be contained in written agreements between airport users and the tower concerned.

AIRPORT TRAFFIC CONTROL SERVICE—A service provided by a control tower, for aircraft operating on the movement area and in the vicinity of an airport.

AIR ROUTE SURVEILLANCE RADAR (ARSR)—Air route traffic control center (ARTCC) radar used primarily to detect and display an aircraft's position while en route between terminal areas. The ARSR enables controllers to provide radar air traffic control service when aircraft are within the ARSR coverage. In some instances, ARSR may enable an ARTCC to provide terminal radar services similar to but usually more limited than those provided by a radar approach control.

AIR ROUTE TRAFFIC CONTROL CENTER (ARTCC)—A facility established to provide air traffic control service to aircraft operating on IFR flight plans within controlled airspace and principally during the en route phase of flight. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to VFR aircraft. (See NAS Stage A; En Route Air Traffic Control Service.)

AIRSPEED—The speed of an aircraft relative to its surrounding air mass. The unqualified term "airspeed" means one of the following:

1. Indicated Airspeed—The speed shown on the aircraft airspeed indicator. This is the speed used in pilot/controller communications under the general term "airspeed."
2. True Airspeed—The airspeed of an aircraft relative to undisturbed air. Used primarily in flight planning and en route portion of flight. When used in pilot/controller communications, it is referred to as "true airspeed" and not shortened to "airspeed."

AIR TAXI—Used to describe a helicopter/VTOL aircraft movement conducted above the surface but normally not above 100 feet AGL. The aircraft may proceed either via hover taxi or flight at speeds of more than 20 knots. The pilot is solely responsible for selecting a safe airspeed/altitude for the operation being conducted. (See Hover Taxi.)

AIR TRAFFIC—Aircraft operating in the air or on an airport surface, exclusive of loading ramps and parking areas.

AIR TRAFFIC CLEARANCE (ATC) CLEARANCE—An authorization by air traffic control, for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled airspace. (See ATC Instructions.)

AIR TRAFFIC CONTROL (ATC)—A service operated by appropriate authority to promote the safe, orderly, and expeditious flow of air traffic.

AIR TRAFFIC CONTROL SPECIALIST/CONTROLLER—A person authorized to provide air traffic control service. (See Air Traffic Control; Flight Service Station.)

AIRWAY BEACON—Used to mark airway segments in remote mountain areas. The light flashes Morse code to identify the beacon site.

AIRWAY/FEDERAL AIRWAY—A control area or portion thereof established in the form of a corridor, the centerline of which is defined by radio navigational aids. (Refer to FAR Part 71.)

ALERT AREA—(See Special Use Airspace.)

ALERT NOTICE (ALNOT)—A message sent by a Flight Service Station (FSS) or Air Route Traffic Control Center (ARTCC), that requests an extensive communication search for overdue, unreported, or missing aircraft.

ALPHANUMERIC DISPLAY/DATA BLOCK—Letters and numerals used to show identification, altitude, beacon code, and other information concerning a target on a radar display. (See Automated Radar Terminal Systems; NAS Stage A.)

ALTERNATE AIRPORT—An airport at which an aircraft may land if a landing at the intended airport becomes inadvisable.

ALTIMETER SETTING—The barometric pressure reading used to adjust a pressure altimeter for variations in existing atmospheric pressure or to the standard altimeter setting (29.92). (Refer to FAR Part 91.)

ALTITUDE—The height of a level, point, or object, measured in feet Above Ground Level (AGL) or from Mean Sea Level (MSL). (See Flight Level.)

1. MSL Altitude—Altitude expressed in feet, measured from mean sea level.
2. AGL Altitude—Altitude expressed in feet, measured above ground level.
3. Indicated Altitude—The altitude as shown by an altimeter. On a pressure or barometric altimeter, it is altitude as shown, uncorrected for instrument error and uncompensated for variation from standard atmospheric conditions.

altitude readout/automatic altitude report—An aircraft's altitude, transmitted via the Mode C transponder feature, that is visually displayed in 100-foot increments on a radarscope having readout capability. (See NAS Stage A; Alphanumeric Display.)

ALTITUDE RESERVATION (ALTRV)—Airspace utilization under prescribed conditions normally employed for the mass movement of aircraft or other special user requirements which cannot otherwise be accomplished. ALTRVs are approved by the appropriate FAA facility.

ALTITUDE RESTRICTION—An altitude or altitudes stated in the order flown which are to be maintained until reaching a specific point or time. Altitude restrictions may be issued by ATC due to traffic, terrain, or other airspace considerations.

altitude restrictions are cancelled—Adherence to previously imposed altitude restrictions is no longer required during a climb or descent.

APPROACH CLEARANCE—Authorization by ATC for a pilot to conduct an instrument approach. The type of instrument approach for which clearance and other pertinent information is provided in the approach clearance when required. (See Instrument Approach Procedure; Cleared for Approach.) (Refer to FAR Part 91.)

APPROACH CONTROL FACILITY—A terminal ATC facility that provides approach control service in a terminal area. (See Approach Control Service; Radar Approach Control Facility.)

APPROACH CONTROL SERVICE—Air traffic control service provided by an approach control facility for arriving and departing VFR/IFR aircraft and, on occasion, en route aircraft. At some airports not served by an approach control facility, the ARTCC provides limited approach control service.

APPROACH GATE—The point on the final approach course which is 1 mile from the final approach fix on the side away from the airport or 5 miles from landing threshold, whichever is farthest from the landing threshold. This is an imaginary point used within ATC as a basis for final approach course interception for aircraft being vectored to the final approach course.

APPROACH LIGHT SYSTEM—(See Airport Lighting.)

APPROACH SEQUENCE—The order in which aircraft are positioned while on approach or awaiting approach clearance. (See Landing Sequence.)

approach speed—The recommended speed contained in aircraft manuals, used by pilots when making an approach to landing. This speed varies for different segments of an approach as well as for aircraft weight and configuration.

APRON/RAMP—A defined area, on a land airport, intended to accommodate aircraft for purposes of loading or unloading passengers or cargo, refueling, parking, or maintenance. With regard to seaplanes, a ramp is used for access to the apron from the water.

ARC—The track over the ground of an aircraft flying at a constant distance from a navigational aid by reference to distance measuring equipment (DME).

AREA NAVIGATION (RNAV)—A method of navigation that permits aircraft operations on any desired course within the coverage of station-referenced navigation signals or within the limits of self-contained system capability. (Refer to FAR Part 71.)

1. Area Navigation Low Route—An area navigation route within the airspace extending upward from 1,200 feet above the surface of the earth to, but not including, 18,000 feet MSL.
2. Area Navigation High Route—An area navigation route within the airspace extending upward from and including 18,000 feet MSL to flight level 450.
3. Random Area Navigation Routes/Random RNAV Routes—Direct routes, based on area navigation capability, between waypoints defined in terms of degree/distance fixes or offset from published or established routes/airways at specified distance and direction.
4. RNAV WAYPOINT (WP)—A predetermined geographical position used for route or instrument approach definition or progress reporting purposes that is defined relative to a VORTAC station position.

ARRESTING SYSTEM—A safety device consisting of two major components, namely, engaging or catching devices, and energy absorption devices for the purpose of arresting both tail hook and/or nontail hook-equipped aircraft. It is used to prevent aircraft from overrunning runways when the aircraft cannot be stopped after landing or during aborted takeoff. Arresting systems have various names, e.g., arresting gear, hook, device, wire, barrier cable. (See Abort.)

ARRIVAL TIME—The time an aircraft touches down on arrival.

ARTCC—(See Air Route Traffic Control Center.)

ASR APPROACH—(See Surveillance Approach.)

ATC advises—Used to prefix a message of noncontrol information when it is relayed to an aircraft by other than an air traffic controller. (See Advisory.)

ATC ASSIGNED AIRSPACE (ATCAA)—Airspace of defined vertical/lateral limits (assigned by ATC) for the purpose of providing air traffic segregation between the specified activities being conducted within the assigned airspace and other IFR air traffic. (See Military Operations Area; Alert Area.)

ATC CLEARANCE—(See Air Traffic Clearance.)

ATC clears—Used to prefix an ATC clearance when it is relayed to an aircraft by other than an air traffic controller.

ATC INSTRUCTION—Directives issued by air traffic control for the purpose of requiring a pilot to take specific actions, e.g., "Turn left heading two five zero," "Go around," "Clear the runway." (Refer to FAR Part 91.)

ATCRBS—(See Radar.)

ATC requests—Used to prefix an ATC request when it is relayed to an aircraft by other than an air traffic controller.

AUTOMATIC CARRIER LANDING SYSTEM (ACLS)—U.S. Navy final approach equipment consisting of precision tracking radar coupled to a computer data link to provide continuous information to the aircraft, monitoring capability to the pilot, and a backup approach system.

AUTOMATIC DIRECTION FINDER (ADF)—An aircraft radio navigation system which senses and indicates the direction to an L/MF nondirectional radio beacon (NDB) ground transmitter. Direction is indicated to the pilot as a magnetic bearing or as a relative bearing to the longitudinal axis of the aircraft depending on the type of indicator installed in the aircraft. In certain applications, such as military, ADF operations may be based on airborne and ground transmitters in the VHF/UHF frequency spectrum.

AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS)—The continuous broadcast of recorded noncontrol information in selected terminal areas. Its purpose is to improve controller effectiveness and to relieve frequency congestion by automating the repetitive transmission of essential but routine information. An example of this is: "Los Angeles information Alpha. One three zero zero Greenwich, Weather, measured ceiling two thousand overcast, visibility three, haze, smoke, temperature seven one, wind two five zero at five, altimeter two niner niner six. I-L-S Runway Two Five Left Approach in use, Runway Two Five Right closed, advise you have Alpha."

AUTOROTATION—A rotorcraft flight condition in which the lifting rotor is driven entirely by action of the air when the rotorcraft is in motion.

1. Autorotative Landing/Touchdown Autorotation—Used by a pilot to indicate that he will be landing without applying power to the rotor.
2. Low Level Autorotation—Commences at an altitude well below the traffic pattern, usually below 100 feet AGL and is used primarily for tactical military training.
3. 180° Autorotation—Initiated from a downwind heading and is commenced well inside the normal traffic pattern. "Go around" may not be possible during the latter part of this maneuver.

AVIATION WEATHER SERVICE—A service provided by the National Weather Service (NWS) and FAA, which collects and disseminates pertinent weather information for pilots, aircraft operators, and ATC. Available aviation weather reports and forecasts are displayed at each NWS office and FAA FSS.

BASE LEG—(See Traffic Pattern.)

BEARING—The horizontal direction to or from any point, usually measured clockwise from true north, magnetic north or some other reference point, through 360°.

below minimums—Weather conditions below the minimums prescribed by regulation for the particular action involved, e.g., landing minimums, takeoff minimums.

BLAST FENCE—A barrier used to divert or dissipate jet or propeller blast.

BLIND SPEED—The rate of departure or closing of a target relative to the radar antenna at which cancellation of the primary radar target by moving target indicator (MTI) circuits in the radar equipment causes a reduction or complete loss of signal.

BLIND SPOT/BLIND ZONE—An area from which radio transmissions and/or radar echoes cannot be received. The term is also used to describe portions of the airport not visible from the control tower.

BOUNDARY LIGHTS—(See Airport Lighting.)

braking action (good, fair, poor, or nil)—A report of conditions on the airport movement area providing a pilot with a degree/quality of braking that he might expect. Braking action is reported in terms of good, fair, poor or nil. (See Runway Condition Reading.)

BROADCAST—Transmission of information for which an acknowledgment is not expected.

CALL-UP—Initial voice contact between a facility and an aircraft, using the identification of the unit being called and the unit initiating the call.

CARDINAL ALTITUDES OR FLIGHT LEVELS—"Odd" or "Even" thousand-foot altitudes or flight levels, e.g., 5,000, 6,000, 7,000, FL 250, FL 260, FL 270. (See Altitude; Flight Levels.)

CEILING—The height above the earth's surface, of the lowest layer of clouds or obscuring phenomena that is reported as "broken," "overcast," or "obscuration," and not classified as "thin" or "partial."

CELESTIAL NAVIGATION—The determination of geographical position by reference to celestial bodies. Normally used in aviation as a secondary means of position determination.

CENTER'S AREA—The specified airspace within which an air route traffic control center (ARTCC) provides air traffic control and advisory service.

CHAFF—Thin, narrow, metallic reflectors of various lengths and frequency responses, used to reflect radar energy. These reflectors when dropped from aircraft and allowed to drift downward result in large targets on the radar display.

chase/chase aircraft—An aircraft flown in proximity to another aircraft normally to observe its performance during training or testing.

CIRCLE-TO-LAND MANEUVER/CIRCLING MANEUVER—A maneuver initiated by the pilot, to align the aircraft with a runway for landing when a straight-in landing from an instrument approach is not possible or is not desirable. This maneuver is made only after ATC authorization has been obtained and the pilot has established required visual reference to the airport. (See Circle to Runway; Landing Minimums.)

circle to runway (runway number)—Used by ATC to inform the pilot that he must circle to land because the runway in use is other than the runway aligned with the instrument approach procedure. When the direction of the circling maneuver in relation to the airport/runways is required, the controller states the direction (eight cardinal compass points) and specifies a left or right downwind or base leg as approrpriate—e.g., "Cleared VOR Runway three six approach circle to Runway two two" or "Circle northwest of the airport for a right downwind to Runway two two."

circling approach—(See Circle-to-land Maneuver.)

CIRCLING MINIMA—(See Landing Minimums.)

CLEAR-AIR TURBULENCE (CAT)—Turbulence encountered in air where no clouds are present. This term is commonly applied to high-level turbulence associated with wind shear. CAT is often encountered in the vicinity of the jet stream. (See Wind Shear; Jet Stream.)

CLEARANCE LIMIT—The fix, point, or location to which an aircraft is cleared when issued an air traffic clearance.

clearance void if not off by (time)—Used by ATC to advise an aircraft that the departure clearance is automatically canceled if takeoff is not made prior to a specified time. The pilot must obtain a new clearance or cancel the IFR flight plan if not off by the specified time.

cleared as filed—Means the aircraft is cleared to proceed in accordance with the route of flight filed in the flight plan. This clearance does not include the altitude, SID, or SID Transition. (See Request Full Route Clearance.)

cleared for (type of) **approach**—ATC authorization for an aircraft to execute a specific instrument approach procedure to an airport, e.g., "Cleared for ILS Runway Three Six Approach." (See Instrument Approach Procedure; Approach Clearance.)

cleared for approach—ATC authorization for an aircraft to execute any standard or special instrument approach procedure for that airport. Normally, an aircraft is cleared for a specific instrument approach procedure. (See Instrument Approach Procedure; Cleared for (Type of) Approach.)

cleared for takeoff—ATC authorization for an aircraft to depart. It is predicated on known traffic and known physical airport conditions.

cleared for the option—ATC authorization for an aircraft to make a touch-and-go, low approach, missed approach, stop-and-go, or full stop landing at the discretion of the pilot. It is normally used in training so that an instructor can evaluate a student's performance under changing situations. (See Option Approach.)

cleared through—ATC authorization for an aircraft to make intermediate stops at specified airports without refiling a flight plan while en route to the clearance limit.

cleared to land—ATC authorization for an aircraft to land. It is predicated on known traffic and known physical airport conditions.

CLIMBOUT—That portion of flight operation between takeoff and the initial cruising altitude.

climb to VFR—ATC authorization for an aircraft to climb to VFR conditions within a control zone when the only weather limitation is restricted visibility. The aircraft must remain clear of clouds while climbing to VFR. (See Special VFR.)

CLOSED RUNWAY—A runway that is unusable for aircraft operations. Only the airport management/military operations office can close a runway.

CLOSED TRAFFIC—Successive operations involving takeoffs and landings or low approaches where the aircraft does not exit the traffic pattern.

CLUTTER—In radar operations, clutter refers to the reception and visual display of radar returns caused by precipitation, chaff, terrain, numerous aircraft targets, or other phenomena. Such returns may limit or preclude ATC from providing services based on radar.

CODES/TRANSPONDER CODES—The number assigned to a particular multiple-pulse reply signal transmitted by the transponder. (See Discrete Code.)

COMBINED CENTER RAPCON (CERAP)—An air traffic facility which combines the functions of an ARTCC and a radar approach control facility. (See Air Route Traffic Control Center (ARTCC); Radar Approach Control Facility.)

COMPASS LOCATOR—A low-power, low- or medium-frequency (L/MF) radio beacon installed at the site of the outer or middle marker of an instrument landing system (ILS). It can be used for navigation at distances of approximately 15 miles or as authorized in the approach procedure.

1. Outer Compass Locator (LOM)—A compass locator installed at the site of the outer marker of an instrument landing system. (See Outer Marker.)

2. Middle Compass Locator (LMM)—A compass locator installed at the site of the middle marker of an instrument landing system. (See Middle Marker.)

COMPASS ROSE—A circle, graduated in degrees, printed on some charts or marked on the ground at an airport. It is used as a reference to either true or magnetic direction.

COMPOSITE FLIGHT PLAN—A flight plan which specifies VFR operation for one portion of flight and IFR for another portion. It is primarily used in military operations.

COMPULSORY REPORTING POINTS—Reporting points which must be reported to ATC. They are designated on aeronautical charts by solid triangles or filed in a flight plan as fixes selected to define direct routes. These points are geographical locations which are defined by navigation aids/fixes. Pilots should discontinue position reporting over compulsory reporting points when informed by ATC that their aircraft is in "radar contact."

CONFLICT ALERT—A function of certain air traffic control automated systems designed to alert radar controllers to existing or pending situations recognized by the program parameters, that require immediate attention/action.

CONSOLAN—A low-frequency, long-distance NAVAID used principally for transoceanic navigation.

contact—

1. Establish communications with (the name of the facility and, if appropriate, the frequency to be used).

2. A flight condition wherein the pilot ascertains the attitude of his aircraft and navigates by visual reference to the surface. (See Contact Approach; Radar Contact.)

contact approach—An approach wherein an aircraft on an IFR flight plan, having an air traffic control authorization, operating clear of clouds, with at least 1-mile flight visibility and a reasonable expectation of continuing to the destination airport in those

conditions, may deviate from the instrument approach procedure and proceed to the destination airport by visual reference to the surface. This approach is only authorized when requested by the pilot, and the reported ground visibility at the destination is at least 1 statute mile.

CONTERMINOUS UNITED STATES—The 48 adjoining states and the District of Columbia.

CONTINENTAL CONTROL AREA—(See Controlled Airspace.)

CONTINENTAL UNITED STATES—The 49 states located on the continent of North America, and the District of Columbia.

CONTROL AREA—(See Controlled Airspace.)

CONTROLLED AIRSPACE—Airspace, designated as a continental control area, control area, control zone, terminal control area, transition area, or positive control area, within which some or all aircraft may be subject to air traffic control. (For definitions, refer to FAR Part 71.)

CONTROL SLASH—A radar beacon slash representing the actual position of the associated aircraft. Normally, the control slash is the one closest to the interrogating radar beacon site. When ARTCC radar is operating in narrowband (digitized) mode, the control slash is converted to a target symbol.

CONTROL ZONE—(See Controlled Airspace.)

convective SIGMET/CONVECTIVE SIGNIFICANT METEOROLOGICAL INFORMATION—A weather advisory concerning convective weather significant to the safety of all aircraft. Convective SIGMETs are issued for tornadoes, lines of thunderstorms, embedded thunderstorms greater than or equal to VIP level 4 with an areal coverage of 4/10 (40%) or more, and hail 3/4 inch or greater. (See SIGMET, AIRMET.)

COORDINATES—The intersection of lines of reference, usually expressed in degrees/minutes/seconds of latitude and longitude, used to determine position or location.

COORDINATION FIX—The fix, in relation to which facilities will hand-off, transfer control of an aircraft, or coordinate flight progress data. For terminal facilities, it may also serve as a clearance for arriving aircraft.

correction—An error has been made in the transmission and the correct version follows:

course—

1. The intended direction of flight in the horizontal plane, measured in degrees from north.
2. The ILS localizer signal pattern usually specified as front course or back course. (See Bearing; *Radial; Instrument Landing Systems.)*

cross (fix) **at** (altitude)—Used by ATC when a specific altitude restriction at a specified fix is required.

cross (fix) **at or above** (altitude)—Used by ATC when an altitude restriction at a specified fix is required. It does not prohibit the aircraft from crossing the fix at a higher altitude than specified; however, the higher altitude may not be one that violates a succeeding altitude restriction or altitude assignment. (See Altitude Assignment; Altitude Restriction.)

cross (fix) **at or below** (altitude)—Used by ATC when a maximum crossing altitude at a specific fix is required. It does not prohibit the aircraft from crossing the fix at a lower altitude; however, it must be at or above the minimum IFR altitude. (See Minimum IFR Altitude; Altitude Restriction.) (Refer to FAR Part 91.)

CROSSWIND—

1. When used concerning the traffic pattern, the word means "crosswind leg." (See Traffic Pattern.)
2. When used concerning wind conditions, the word means a wind not parallel to the runway or to the path of an aircraft. (See Crosswind Component.)

CROSSWIND COMPONENT—The wind component measured in knots at 90° to the longitudinal axis of the runway.

cruise—Used in an ATC clearance to authorize a pilot to conduct flight at any altitude from the minimum IFR altitude up to and including the altitude specified in the clearance. The pilot may level off at any intermediate altitude within this block of airspace. Climb/descent within the block is to be made at the discretion of the pilot. However, once the pilot starts descent and verbally reports leaving an altitude in the block, he may not return to that altitude without additional ATC clearance. Further, it is approval for the pilot to proceed to and make an approach at destination airport and can be used in conjunction with:

1. An airport clearance limit at locations with a standard/special instrument approach procedure.

The FARs require that if an instrument letdown to an airport is necessary, the pilot shall make the letdown in accordance with a standard/special instrument approach procedure for that airport; or

2. An airport clearance limit at locations that are within/below/outside controlled airspace and without a standard/special instrument approach procedure. Such a clearance is NOT AUTHORIZATION for the pilot to descend under IFR conditions below the applicable minimum IFR altitude nor does it imply that ATC is exercising control over aircraft in uncontrolled airspace; however, it provides a means for the aircraft to proceed to destination airport, descend, and land in accordance with applicable FARs governing VFR flight operations. Also, this provides search and rescue protection until such time as the IFR flight plan is closed. (See Instrument Approach Procedure.)

CRUISING ALTITUDE/LEVEL—An altitude or flight level maintained during en route level flight. This is a constant altitude and should not be confused with a cruise clearance. (See Altitude.)

DECISION HEIGHT (DH)—Regarding the operation of aircraft, it means the height at which a decision must be made during an ILS or PAR instrument approach, to either continue the approach or to execute a missed approach.

DECODER—The device used to decipher signals received from ATCRBS transponders to effect their display as select codes. (See Codes; Radar.)

DEFENSE VISUAL FLIGHT RULES (DVFR)—Rules applicable to flights within an ADIZ conducted under the visual flight rules in FAR Part 91. (See Air Defense Identification Zone.) (Refer to FAR Part 99.)

delay indefinite (reason if known) **expect further clearance** (time)—Used by ATC to inform a pilot when an accurate estimate of the delay time and the reason for the delay cannot immediately be determined, e.g., a disabled aircraft on the runway, terminal or center area saturation, weather below landing minimums, etc. (See Expect Further Clearance.)

DEPARTURE CONTROL—A function of an approach control facility providing air traffic control service for departing IFR and, under certain conditions, VFR aircraft. (See Approach Control.)

DEPARTURE TIME—The time an aircraft becomes airborne.

DEVIATIONS—

1. A departure from a current clearance, such as an off course maneuver to avoid weather or turbulence.

2. Where specifically authorized in the FARs and requested by the pilot, ATC may permit pilots to deviate from certain regulations.

DF APPROACH PROCEDURE—Used under emergency conditions where another instrument approach procedure cannot be executed. DF guidance for an instrument approach is given by ATC facilities with DF capability. (See DF Guidance; Direction Finder.)

DF FIX—The geographical locations of an aircraft obtained by one or more direction finders. (See Direction Finder.)

DF GUIDANCE/DF STEER—Headings provided to aircraft by facilities equipped with direction finding equipment. These headings, if followed, lead the aircraft to a predetermined point such as the DF station or an airport. DF guidance is given to aircraft in distress or to other aircraft which request the service. Practice DF guidance is provided when workload permits. (See Direction Finder; DF Fix.)

direct—Straight line flight between two navigational aids, fixes, points, or any combination thereof. When used by pilots in describing off-airway routes, points defining direct route segments become compulsory reporting points unless the aircraft is under radar contact.

DIRECTION FINDER (DF/UDF/VDF/UVDF)—A radio receiver equipped with a directional sensing antenna used to take bearings on a radio transmitter. Specialized radio direction finders are used in aircraft as air navigation aids. Others are ground based primarily to obtain a "fix" on a pilot requesting orientation assistance or to locate downed aircraft. A location "fix" is established by the intersection of two or more bearing lines plotted on a navigational chart using either two separately located Direction Finders to obtain a fix on an aircraft or by a pilot plotting the bearing indications of his DF on two separately located ground based transmitters, both of which can be identified on the pilot's chart. (See DF Guidance; DF Fix.)

DISCRETE CODE/DISCRETE BEACON CODE—As used in the Air Traffic Control Radar Beacon System (ATCRBS), any one of the 4096 selectable Mode 3/A aircraft transponder codes except those ending in zero zero, e.g., discrete codes: 0010, 1201, 2317, 7777; nondiscrete codes: 0100, 1200, 7700. Nondiscrete codes are normally reserved for radar facilities that are not equipped with discrete decoding capability and for other purposes such as emergencies (7700), VFR aircraft (1200), etc. (See Radar.)

DISCRETE FREQUENCY—A separate radio frequency for use in direct pilot-controller communications in air traffic control which reduces frequency congestion by controlling the number of aircraft operating on a particular frequency at one time. Discrete frequencies are normally designated for each control sector in en route/terminal ATC facilities. Discrete frequencies are listed in the Airport/Facility Directory and the DOD FLIP IFR En Route Supplement.

DISPLACED THRESHOLD—A threshold that is located at a point on the runway other than the designated beginning of the runway. (See Threshold.)

DISTANCE-MEASURING EQUIPMENT (DME)—Equipment (airborne and ground) used to measure, in nautical miles, the slant range distance of an aircraft from the DME navigational aid. (See TACAN; VORTAC.)

DISTRESS—A condition of being threatened by serious and/or imminent danger, and of requiring immediate assistance.

DME FIX—A geographical position determined by reference to a navigational aid which provides distance and azimuth information. It is defined by a specific distance in nautical miles and a radial or course (i.e., localizer) in degrees magnetic from that aid. (See Distance-Measuring Equipment (DME), Fix.)

DME SEPARATION—Spacing of aircraft in terms of distances (nautical miles) determined by reference to distance-measuring equipment (DME). (See Distance-Measuring Equipment (DME).)

DOD FLIP—Department of Defense Flight Information Publications used for flight planning, en route, and terminal operations. FLIP is produced by the Defense Mapping Agency for worldwide use. United States Government Flight Information Publications (en route charts and instrument approach procedure charts) are incorporated in DOD FLIP for use in the National Airspace System (NAS).

DOWNWIND LEG—(See Traffic Pattern.)

DRAG CHUTE—A parachute device installed on certain aircraft, which is deployed on landing roll to assist in deceleration of the aircraft.

EMERGENCY—A *Distress* or *Urgency* condition.

EMERGENCY LOCATOR TRANSMITTER (ELT)—A radio transmitter attached to the aircraft structure which operates from its own power source on 121.5 MHz and 243.0 MHz. It aids in locating downed aircraft by radiating a downward sweeping audio tone, two to four times per second. It is designed to function without human action after an accident. (Refer to FAR Part 91.)

EMERGENCY SAFE ALTITUDE—(See Minimum Safe Altitude.)

EN ROUTE AIR TRAFFIC CONTROL SERVICES—Air traffic control service provided aircraft on IFR flight plans (generally by centers) when these aircraft are operating between departure and destination terminal areas. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to VFR aircraft. (See NAS Stage A; Air Route Traffic Control Center.)

EN ROUTE CHARTS—(See Aeronautical Charts.)

EN ROUTE DESCENT—Descent from the en route cruising altitude which takes place along the route of flight.

execute missed approach—Instructions issued to a pilot making an instrument approach which means continue inbound to the missed approach point and execute the missed approach procedure as described on the Instrument Approach Procedure Chart, or as previously assigned by ATC. The pilot may climb immediately to the altitude specified in the missed approach procedure upon making a missed approach. No turns should be initiated prior to reaching the missed approach point. When conducting an ASR or PAR approach, execute the assigned missed approach procedure immediately upon receiving instructions to "execute missed approach."

expect (altitude) **at** (time) **or** (fix)—Used under certain conditions in a departure clearance to provide a pilot with an altitude to be used in the event of two-way communication failure.

expect departure clearance (time)/EDCT—Used in Fuel Advisory Departure (FAD) program. The time the operator can expect a gate release. Excluding long-distance flights, an EDCT is always assigned even though it may be the same as the Estimated Time of Departure (ETD). The EDCT is calculated by adding the ground delay factor. (See Fuel Advisory Departure.)

expect further clearance (time) (EFC)—The time a pilot can expect to receive clearance beyond a clearance limit.

expect further clearance via (airways, routes, or fixes)—Used to inform pilot of the routing expected if any part of the route beyond a short range clearance limit differs from that filed.

expedite—Used by ATC when prompt compliance is required to avoid the development of an imminent situation.

FEATHERED PROPELLER—A propeller whose blades have been rotated so that the leading and trailing edges are nearly parallel with the aircraft flight path to stop or minimize drag and engine rotation. Normally used to indicate shutdown of a reciprocating or turboprop engine due to malfunction.

FILED—Normally used in conjunction with flight plans, meaning a flight plan has been submitted to ATC.

final—Commonly used to mean that an aircraft is on the final approach course or is aligned with a landing area.

FINAL APPROACH COURSE—A straight line extension of a localizer, a final approach radial/bearing, or a runway centerline, all without regard to distance. (See Final Approach—IFR; Traffic Pattern.)

FINAL APPROACH FIX (FAF)—The designated fix from or over which the final approach (IFR) to an airport is executed. The FAF identifies the beginning of the final approach segment of the instrument approach.

FINAL APPROACH (IFR)—The flight path of an aircraft which is inbound to an airport on a final instrument approach course, beginning at the final approach fix or point and extending to the airport or the point where a circle to land maneuver or a missed approach is executed.

FINAL APPROACH POINT—The point, within prescribed limits of an instrument approach procedure, where the aircraft is established on the final approach course and final approach descent may be commenced. A final approach point is applicable only in nonprecision approaches where a final approach fix has not been established. In such instances, the point identifies the beginning of the final approach segment of the instrument approach.

FINAL APPROACH SEGMENT—(See Segments of an Instrument Approach Procedure.)

FINAL APPROACH-VFR—(See Traffic Pattern.)

FINAL CONTROLLER—The controller providing information and final approach guidance during PAR and ASR approaches using radar equipment. (See Radar Approach.)

FIX—A geographical position determined by visual reference to the surface, by reference to one or more radio NAVAIDs, by celestial plotting, or by another navigational device.

FIXED-WING SPECIAL IFR/FW/SIFR—Aircraft operating in accordance with a waiver and a Letter of Agreement within control zones specified in FAR 93.113. These operations are conducted by IFR qualified pilots in IFR equipped aircraft and by pilots of agricultural and industrial aircraft.

FLAMEOUT—Unintended loss of combustion in turbine engines resulting in the loss of engine power.

FLIGHT CHECK—A call-sign prefix used by FAA aircraft engaged in flight inspection/certification of navigational aids and flight procedures. The word "recorded" may be added as a suffix; e.g., "Flight Check 320 recorded" to indicate that an automated flight inspection is in progress to terminal areas. (See *Flight Inspection/Flight Check.*)

FLIGHT INFORMATION REGION (FIR)—An airspace of defined dimensions within which Flight Information Service and Alerting Service are provided.

1. Flight Information Service—A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.

2. Alerting Service—A service provided to notify appropriate organizations regarding aircraft in need of search and rescue aid and to assist such organizations as required.

FLIGHT INSPECTION/FLIGHT CHECK—Inflight investigation and evaluation of a navigational aid to determine whether it meets established tolerances. (See Navigational Aid.)

flight level—A level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury. Each is stated in three digits that represent hundreds of feet. For example, flight level 250 represents a barometric altimeter indication of 25,000 feet; flight level 255, an indication of 25,500 feet.

FLIGHT PATH—A line, course, or track along which an aircraft is flying or is intended to be flown.

FLIGHT PLAN—Specified information relating to the intended flight of an aircraft that is filed orally or in writing with an FSS or an ATC facility.

FLIGHT SERVICE STATION (FSS)—Air traffic facilities which provide pilot briefing, en route communications and VFR search and rescue services, assist lost aircraft and aircraft in emergency situations, relay ATC clearances, originate Notices to Airmen, broadcast aviation weather and NAS information, receive and process IFR flight plans, and monitor NAVAIDs. In addition, at selected locations FSSs provide En Route Flight Advisory Service (Flight Watch), take weather observations, issue airport advisories, and advise Customs and Immigration of transborder flights.

FLIGHT TEST—A flight for the purpose of:

1. Investigating the operation/flight characteristics of an aircraft or aircraft component.
2. Evaluating an applicant for a pilot certificate or rating.

FLIGHT VISIBILITY—(See Visibility.)

FLIP—(See DOD FLIP.)

FLOW CONTROL—Measures designed to adjust the flow of traffic into a given airspace, along a given route, or bound for a given aerodrome (airport) so as to ensure the most effective utilization of the airspace.

fly heading (degrees)—Informs the pilot of the heading to be flown. The pilot may have to turn to, or continue on, a specific compass direction in order to comply with the instructions. The pilot is expected to turn in the shorter direction to the heading, unless otherwise instructed by ATC.

FORMATION FLIGHT—More than one aircraft which, by prior arrangement between the pilots, operate as a single aircraft with regard to navigation and position reporting. Separation between aircraft within the formation is the responsibility of the flight leader and the pilots of the other aircraft in the flight. This includes transition periods when aircraft within the formation are maneuvering to attain separation from each other to effect individual control and during join-up and breakaway.

1. A standard formation is one in which a proximity of no more than 1 mile laterally or longitudinally and within 100 feet vertically from the flight leader is maintained by each wingman.

2. Nonstandard formations are those operating under any of the following conditions:

a. When the flight leader has requested and ATC has approved other than standard formation dimensions.

b. When operating within an authorized altitude reservation (ALTRV) or under the provisions of a Letter of Agreement.

c. When the operations are conducted in airspace specifically designed for a special activity. (See Altitude Reservation.) (Refer to FAR Part 91.)

FSS—(See Flight Service Station.)

FUEL ADVISORY DEPARTURE (FAD)—Procedures to minimize engine running time for aircraft destined for an airport experiencing prolonged arrival delays.

FUEL DUMPING—Airborne release of usable fuel. This does not include the dropping of fuel tanks. (See Jettisoning of External Stores.)

GATE HOLD PROCEDURES—Procedures at selected airports to hold aircraft at the gate or other ground location whenever departure delays exceed or are anticipated to exceed 5 minutes. The sequence for departure is maintained in accordance with initial callup unless modified by Flow Control restrictions. Pilots should monitor the ground control/clearance delivery frequency for engine startup advisories or new proposed start time if the delay changes. (See Flow Control.)

GENERAL AVIATION—That portion of civil aviation which encompasses all facets of aviation except air carriers holding a certificate of public convenience and necessity from the Civil Aeronautics Board, and large aircraft commercial operators.

glide path (on/above/below)—Used by ATC to inform an aircraft making a PAR approach of its vertical position (elevation) relative to the descent profile. The terms "slightly" and "well" are used to describe the degree of deviation, e.g., "slightly above glidepath." Trend information is also issued with respect to the elevation of the aircraft and may be modified by the terms "rapidly" and "slowly"—e.g., "well above glidepath, coming down rapidly." (See PAR Approach.)

GLIDE SLOPE (GS)—Provides vertical guidance for aircraft during approach and landing. The glide slope consists of the following:

1 Electronic components emitting signals which provide vertical guidance by reference to airborne instruments during instrument approaches such as ILS, or

2. Visual ground aids, such as VASI, which provide vertical guidance for VFR approach or for the visual portion of an instrument approach and landing.

GLIDE SLOPE INTERCEPT ALTITUDE—The minimum altitude of the intermediate approach segment prescribed for a precision approach which assures required obstacle clearance. It is depicted on instrument approach procedure charts.

go ahead—Proceed with your message. Not to be used for any other purpose.

go around—Instructions for a pilot to abandon his approach to landing. Additional instructions may follow. Unless otherwise advised by ATC, a VFR aircraft or an aircraft conducting a visual approach should overfly the runway while climbing to traffic pattern altitude and enter the traffic pattern via the crosswind leg. A pilot on an IFR flight plan making an instrument approach should execute the published missed approach procedure or proceed as instructed by ATC, e.g., "Go around" (additional instructions, if required). (See Low Approach; Missed Approach.)

GROUND CLUTTER—A pattern produced on the radarscope by ground returns which may degrade other radar returns in the affected area. The effect of ground clutter is minimized by the use of moving target indicator (MTI) circuits in the radar equipment resulting in a radar presentation which displays only targets which are in motion. (See Clutter.)

GROUND CONTROLLED APPROACH (GCA)—A radar approach system operated from the ground by air traffic control personnel transmitting instructions to the pilot by radio. The approach may be conducted with surveillance radar (ASR) only or with both surveillance and precision approach radar (PAR). Usage of the term "GCA" by pilots is discouraged except when referring to a GCA facility. Pilots should specifically request a "PAR" approach when a precision radar approach is desired, or request an "ASR" or "surveillance" approach when a nonprecision radar approach is desired. (See Radar Approach.)

GROUND SPEED—The speed of an aircraft relative to the surface of the earth.

GROUND VISIBILITY—(See Visibility.)

HANDOFF—An action taken to transfer the radar identification of an aircraft from one controller to another if the aircraft is entering the receiving controller's airspace and radio communications with the aircraft is being transferred.

have numbers—Used by pilots to inform ATC that they have received runway, wind, and altimeter information only.

HEIGHT ABOVE LANDING (HAL)—The height above a designated helicopter landing area used for helicopter instrument approach procedures.

HEIGHT ABOVE TOUCHDOWN (HAT)—The height of the Decision Height or Minimum Descent Altitude above the highest runway elevation in the touchdown zone (first 3,000 feet of the runway). HAT is published on instrument approach charts in conjunction with all straight-in minimums. (See Decision Height, Minimum Descent Altitude.)

HELICOPTER/COPTER—Rotorcraft that, for its horizontal motion, depends principally on its engine-driven rotors.

HELIPAD—That part of the landing and takeoff area designed for helicopters.

HELIPORT—An area of land, water, or structure used or intended to be used for the landing and takeoff of helicopters.

HERTZ (Hz)—The standard radio equivalent of frequency in cycles of an electromagnetic wave per second. Kilohertz (kHz) is a frequency of 1,000 cycles per second. Megahertz (MHz) is a frequency of 1 million cycles per second.

HIGH SPEED TAXIWAY/EXIT/TURNOFF—A long radius taxiway designed and provided with lighting or marking to define the path of aircraft, traveling at high speed (up to 60 knots), from the runway center to a point on the center of a taxiway. Also referred to as long radius exit or turnoff taxiway. The high speed taxiway is designed to expedite aircraft turning off the runway after landing, thus reducing runway occupancy time.

HOLD/HOLDING PROCEDURE—A predetermined maneuver which keeps aircraft within a specified airspace while awaiting further clearance from air traffic control. Also used during ground operations to keep aircraft within a specified area or at a specified point while awaiting further clearance from air traffic control. (See Holding Fix.)

HOLDING FIX—A specified fix identifiable to a pilot by NAVAIDs or visual reference to the ground used as a reference point in establishing and maintaining the position of an aircraft while holding. (See Fix; Hold; Visual Holding.)

HOMING—Flight toward a NAVAID, without correcting for wind, by adjusting the aircraft heading to maintain a relative bearing of 0°. (See Bearing.)

HOVER CHECK—Used to describe when a helicopter/VTOL aircraft requires a stabilized hover to conduct a performance/power check prior to hover taxi, air taxi, or takeoff. Altitude of the hover may vary based on the purpose of the check.

HOVER TAXI—Used to describe a helicopter/VTOL aircraft movement conducted above the surface and in ground effect at airspeeds less than approximately 20 knots. The actual height may vary, and some helicopters may require hover taxi above 25 feet AGL to reduce ground effect turbulence or provide clearance for cargo slingloads. (See Air Taxi; Hover Check.)

how do you hear me?—A question relating to the quality of the transmission or to determine how well the transmission is being received.

ident—A request for a pilot to activate the aircraft transponder identification feature. This will help the controller to confirm an aircraft identity or to identify an aircraft.

IDENT FEATURE—The special feature in the Air Traffic Control Radar Beacon System (ATCRBS) equipment It is used to immediately distinguish one displayed beacon target from other beacon targets. (See Ident.)

if feasible, reduce speed to (speed)—(See Speed Adjustment.)

if no transmission received for (time)—Used by ATC in radar approaches to prefix procedures which should be followed by the pilot in event of lost communications. (See Lost Communications.)

IFR AIRCRAFT/IFR FLIGHT—An aircraft conducting flight in accordance with instrument flight rules.

IFR CONDITIONS—Weather conditions below the minimum for flight under visual flight rules. (See Instrument Meteorological Conditions.)

IFR MILITARY TRAINING ROUTES (IR)—Routes used by the Department of Defense and associated Reserve and Air Guard units for the purpose of conducting low-altitude navigation and tactical training in both IFR and VFR weather conditions below 10,000 feet MSL at airspeeds in excess of 250 knots indicated aid speed (IAS).

immediately—Used by ATC when such action compliance is required to avoid an imminent situation.

increase speed to (speed)—(See Speed Adjustment.)

INFORMATION REQUEST (INREQ)—A request originated by an FSS for information concerning an overdue VFR aircraft.

INITIAL APPROACH FIX (IAF)—The fixes depicted on instrument approach procedure charts that identify the beginning of the initial approach segment(s).

INITIAL APPROACH SEGMENT—(See Segments of an Instrument Approach Procedure.)

INNER MARKER (IM) INNER MARKER BEACON—A marker beacon used with an ILS (CAT II) precision approach, located between the middle marker and the end of the ILS runway, transmitting a radiation pattern keyed at six dots per second and indicating to the pilot, both aurally and visually, that he is at the designated decision height (DH), normally 100 feet above the touchdown zone elevation, on the ILS CAT II approach. (See Instrument Landing System.)

INSTRUMENT APPROACH PROCEDURE (IAP) INSTRUMENT APPROACH—A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the

beginning of the initial approach to a landing, or to a point from which a landing may be made visually. It is prescribed and approved for a specific airport by competent authority. (See Segments of an Instrument Approach Procedure.) (Refer to FAR Part 91.)

1. U.S. civil standard instrument approach procedures are approved by the FAA as prescribed under FAR Part 97, and are available for public use.
2. U.S. military standard instrument approach procedures are approved and published by the Department of Defense.
3. Special instrument approach procedures are approved by the FAA for individual operators, but are not published in FAR Part 97, for public use.

INSTRUMENT FLIGHT RULES (IFR)—Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan. (See Visual Flight Rules; Instrument Meteorological Conditions; Visual Meteorological Conditions.)

INSTRUMENT LANDING SYSTEM (ILS)—A precision instrument approach system which normally consists of the following electronic components and visual aids:

1. Localizer. (See Localizer.)
2. Glide Slope. (See Glide Slope.)
3. Outer Marker. (See Outer Marker.)
4. Middle Marker. (See Middle Marker.)
5. Approach Lights. (See Airport Lighting.)

(Refer to FAR Part 91.)

INSTRUMENT METEOROLOGICAL CONDITIONS (IMC)—Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling less than the minima specified for visual meteorological conditions. (See Visual Meteorological Conditions, Instrument Flight Rules, Visual Flight Rules.)

INSTRUMENT RUNWAY—A runway equipped with electronic and visual navigation aids for which a precision or nonprecision approach procedure having straight-in landing minimums has been approved.

INTERMEDIATE APPROACH SEGMENT—(See Segments of an Instrument Approach Procedure.)

INTERMEDIATE FIX (IF)—The fix that identifies the beginning of the intermediate approach segment of an instrument approach procedure. The fix is not normally identified on the instrument approach chart as an intermediate fix (IF). (See Segments of an Instrument Approach Procedure.)

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)—A specialized agency of the United Nations whose objective is to develop the principles and techniques of international air navigation and to foster planning and development of international civil air transport.

INTERROGATOR—The ground-based surveillance radar beacon transmitter-receiver which normally scans in synchronism with a primary radar transmitting discrete radio signals which repetitiously requests all transponders, on the mode being used, to reply. The replies received are mixed with the primary radar returns and displayed on the same plan position indicator (radarscope). Also applied to the airborne element of the TACAN/DME system. (See Transponder.)

INTERSECTING RUNWAYS—Two or more runways which cross or meet within their lengths. (See Intersection.)

INTERSECTION—

1. A point defined by any combination of courses, radials, or bearings of two or more navigational aids.
2. Used to describe the point where two runways cross, a taxiway and a runway cross, or two taxiways cross.

I say again—The message will be repeated.

JAMMING—Electronic or mechanical interference which may disrupt the display of aircraft on radar or the transmission/reception of radio communications/navigation.

JET BLAST—Jet engine exhaust (thrust stream turbulence). (See Wake Turbulence.)

JET ROUTE—A route designed to serve aircraft operations from 18,000 feet MSL up to and including flight level 450. The routes are referred to as "J" routes with numbering to identify the designated route, e.g., J 105. (See Route.) (Refer to FAR Part 71.)

JET STREAM—A migrating stream of high-speed winds present at high altitudes.

JETTISONING OF EXTERNAL STORES—Airborne release of external stores, e.g., tiptanks, ordnance. (See Fuel Dumping.) (Refer to FAR Part 91.)

JOINT USE RESTRICTED AREA—(See Restricted Area.)

KNOWN TRAFFIC—Regarding ATC clearances, it means aircraft whose altitude, position, and intentions are known to ATC.

LANDING DIRECTION INDICATOR—A device which visually indicates the direction in which landings and takeoffs should be made. (See Tetrahedron.)

LANDING MINIMUMS/IFR LANDING MINIMUMS—The minimum visibility prescribed for landing a civil aircraft while using an instrument approach procedure. The minimum applies with other limitations set forth in FAR Part 91 with respect to the Minimum Descent Altitude (MDA) or Decision Height (DH) prescribed in the instrument approach procedures as follows:

1. Straight-in landing minimums—A statement of MDA and visibility, or DH and visibility, required for straight-in landing on a specified runway; or

2. Circling minimums—A statement of MDA and visibility required for the circle-to-land maneuver.

Descent below the established MDA or DH is not authorized during an approach unless the aircraft is in a position from which a normal approach to the runway of intended landing can be made, and adequate visual reference to required visual cues is maintained. (See Straight-in Landing, Circle-to-Land Maneuver, Decision Height, Minimum Descent Altitude, Visibility, Instrument Approach Procedure.) (Refer to FAR Part 91.)

LANDING ROLL—The distance from the point of touchdown to the point where the aircraft can be brought to a stop or exits the runway.

LANDING SEQUENCE—The order in which aircraft are positioned for landing. (See Approach Sequence.)

LAST ASSIGNED ALTITUDE—The last altitude/flight level assigned by ATC and acknowledged by the pilot. (See Maintain.) (Refer to FAR Part 91.)

LATERAL SEPARATION—The lateral spacing of aircraft at the same altitude by requiring operation on different routes or in different geographical locations. (See Separation.)

LIGHT GUN—A hand-held directional light signaling device which emits a brilliant narrow beam of white, green, or red light as selected by the tower controller The color and type of light transmitted can be use to approve or disapprove anticipated pilot action where radio communications are not available. Th light gun is used for controlling traffic operating i the vicinity of the airport and on the airport move ment area.

LOCALIZER—The component of an ILS whic provides course guidance to the runway. (See Instru ment Landing System.)

LOCAL TRAFFIC—Aircraft operating in the traffi pattern or within sight of the tower, or aircra known to be departing or arriving from flight in loca practice areas, or aircraft executing practice instru ment approaches at the airport. (See Traffic Pattern.

LONGITUDINAL SEPARATION—The longitudin spacing of aircraft at the same altitude, by a minimu distance expressed in units of time or in miles. (Se Separation.)

LONG RANGE NAVIGATION (LORAN)—An ele tronic navigational system by which hyperbolic line of position are determined by measuring the differen in the time of reception of synchronized pulse signal from two fixed transmitters. Loran A operates in th 1750-1950 kHz frequency band. Loran C and I operate in the 100-110 kHz frequency band.

LOST COMMUNICATIONS/TWO-WAY RADI COMMUNICATIONS FAILURE—Loss of th ability to communicate by radio. Aircraft are some times referred to as NORDO (No Radio). Standar pilot procedures are specified in FAR Part 91. Rada controllers issue procedures for pilots to follow in th event of lost communications during a radar approac when weather reports indicate that an aircraft wi likely encounter IFR weather conditions during th approach. (Refer to FAR Part 91.)

LOW ALTITUDE AIRWAY STRUCTURE FEDERAL AIRWAYS—The network of airwa serving aircraft operations up to but not includin 18,000 feet MSL. (See Airway.)

low altitude alert, check your altitude immediately- (See Safety Advisory.)

LOW APPROACH—An approach over an airpo or runway following an instrument approach or VFR approach including the go-around maneuv where the pilot intentionally does not make conta with the runway.

LOW FREQUENCY (LF)—The frequency band between 30 and 300 kHz.

MACH NUMBER—The ratio of true airspeed to the speed of sound, e.g., MACH .82, MACH 1.6. (See Airspeed.)

maintain—

1. Concerning altitude/flight level, the term means to remain at the altitude/flight level specified. The phrase "climb and" or "descend and" normally precedes "maintain" and the altitude assignment, e.g., "descend and maintain 5,000."

2. Concerning other ATC instructions, the term is used in its literal sense, e.g., maintain VFR.

make short approach—Used by ATC to inform a pilot to alter his traffic pattern so as to make a short final approach. (See Traffic Pattern.)

MANDATORY ALTITUDE—An altitude depicted on an Instrument Approach Chart requiring the aircraft to maintain altitude at the depicted value.

MARKER BEACON—An electronic navigation facility transmitting a 75 MHz vertical fan or bone-shaped radiation pattern. Marker beacons are identified by their modulation frequency and keying code, and when received by compatible airborne equipment, indicate to the pilot, both aurally and visually, that he is passing over the facility. (See Outer Marker, Middle Marker, Inner Marker.)

MAXIMUM AUTHORIZED ALTITUDE (MAA)—A published altitude representing the maximum usable altitude or flight level for an airspace structure or route segment. It is the highest altitude on a Federal airway, Jet route, area navigation low or high route, or other direct route for which an MEA is designated in FAR Part 95, at which adequate reception of navigation and signals is assured.

mayday—The international radiotelephony distress signal. When repeated three times, it indicates imminent and grave danger and that immediate assistance is requested. (See PAN.)

MIA—(See Minimum IFR Altitudes.)

MICROWAVE LANDING SYSTEM (MLS)—An instrument landing system operating in the microwave spectrum which provides lateral and vertical guidance to aircraft having compatible avionics equipment. (See Instrument Landing System.)

MIDDLE COMPASS LOCATOR—(See Compass Locator.)

MIDDLE MARKER (MM)—A marker beacon that defines a point along the glide slope of an ILS normally located at or near the point of decision height (ILS Category I). It is keyed to transmit alternate dots and dashes, two per second, on 1300 Hz tone which is received aurally and visually by compatible airborne equipment. (See Marker Beacon, Instrument Landing System.)

MID RVR—(See Visibility.)

MILITARY AUTHORITY ASSUMES RESPONSIBILITY FOR SEPARATION OF AIRCRAFT (MARSA)—A condition whereby the military services involved assume responsibility for separation between participating military aircraft in the ATC system. It is used only for required IFR operations which are specified in Letters of Agreement or other appropriate FAA or military documents.

MILITARY OPERATIONS AREA (MOA)—(See Special Use Airspace.)

MILITARY TRAINING ROUTES (MTR)—Airspace of defined vertical and lateral dimensions established for the conduct of military flight training at airspeeds in excess of 250 knots IAS. (See IFR (IR) and VFR (VR) Military Training Routes.)

MINIMUM CROSSING ALTITUDE (MCA)—The lowest altitude at certain fixes at which an aircraft must cross when proceeding in the direction of a higher minimum en route IFR altitude (MEA). (See Minimum En Route IFR Altitude.)

MINIMUM DESCENT ALTITUDE (MDA)—The lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure where no electronic glide slope is provided. (See Nonprecision Approach Procedure.)

MINIMUM EN ROUTE IFR ALTITUDE (MEA)—The lowest published altitude between radio fixes which assures acceptable navigational signal coverage and meets obstacle clearance requirements between those fixes. The MEA prescribed for a Federal airway or segment thereof, area navigational low or high route, or other direct route applies to the entire width of the airway, segment, or route between the radio fixes defining the airway, segment, or route. (Refer to FAR Parts 91 and 95.)

MINIMUM FUEL—Indicates that an aircraft's fuel supply has reached a state where, upon reaching the destination, it can accept little or no delay. This is not an emergency situation but merely indicates an emergency situation is possible should any undue delay occur.

MINIMUM HOLDING ALTITUDE (MHA)—The lowest altitude prescribed for a holding pattern which assures navigational signal coverage, communications, and meets obstacle clearance requirements.

MINIMUM IFR ALTITUDES (MIA)—Minimum altitudes for IFR operations as prescribed in FAR Part 91. These altitudes are published on aeronautical charts and prescribed in FAR Part 95 for airways and routes, and in FAR Part 97 for standard instrument approach procedures. If no applicable minimum altitude is prescribed in FAR Parts 95 or 97, the following minimums IFR altitude applies:

1. In designated mountainous areas, 2,000 feet above the highest obstacle within a horizontal distance of 5 statute miles from the course to be flown; or

2. Other than mountainous areas, 1,000 feet above the highest obstacle within a horizontal distance of 5 statute miles from the course to be flown; or

3. As otherwise authorized by the Administrator or assigned by ATC. (See Minimum En Route IFR Altitude, Minimum Obstruction Clearance Altitude, Minimum Crossing Altitude, Minimum Safe Altitude, Minimum Vectoring Altitude.) (Refer to FAR Part 91.)

MINIMUM OBSTRUCTION CLEARANCE ALTITUDE (MOCA)—The lowest published altitude in effect between radio fixes on VOR airways, off-airway routes, or route segments, which meets obstacle clearance requirements for the entire route segment and which assures acceptable navigation signal coverage only within 25 statute miles of a VOR. (Refer to FAR Parts 91 and 95.)

MINIMUM RECEPTION ALTITUDE (MRA)—The lowest altitude at which an intersection can be determined. (Refer to FAR Part 95.)

MINIMUM SAFE ALTITUDE (MSA)—

1. The minimum altitude specified in FAR Part 91, for various aircraft operations.

2. Altitudes depicted on approach charts which provide at least 1,000 feet of obstacle clearance for emergency use within a specified distance from the navigation facility upon which a procedure is predicated. These altitudes are identified as MIN MUM SECTOR ALTITUDES or EMERGENC SAFE ALTITUDES and are established as follow

a. MINIMUM SECTOR ALTITUDES—Al tudes depicted on approach charts which provide least 1,000 feet of obstacle clearance within a 25-m radius of the navigation facility upon which t procedure is predicated. Sectors depicted on approa charts must be at least 90° in scope. These altitud are for emergency use only and do not necessari assure acceptable navigational signal coverage.

b. EMERGENCY SAFE ALTITUDES—Al tudes depicted on approach charts which provi at least 1,000 feet of obstacle clearance in no mountainous areas and 2,000 feet of obstacle clearan in designated mountainous areas within a 100-mi radius of the navigation facility upon which t procedure is predicated and normally used only military procedures. These altitudes are identified published procedures as "Emergency Safe Altitudes

MINIMUM SAFE ALTITUDE WARNIN (MSAW)—A function of the ARTS III comput that aids the controller by alerting him when tracked Mode C equipped aircraft is below or predicted by the computer to go below a predetermin minimum safe altitude.

MINIMUMS/MINIMA—Weather conditions requi ments established for a particular operation or ty of operation: e.g., IFR takeoff or landing, alterna airport for IFR flight plans, VFR flight, etc. (S Landing Minimums, IFR Takeoff Minimums, VF Conditions, IFR Conditions.) (Refer to FAR Part 9

MINIMUM VECTORING ALTITUDE (MVA) The lowest MSL altitude at which an IFR aircraft vectored by a radar controller, except as otherwi authorized for radar approaches, departures, a missed approaches. The altitude meets IFR obsta clearance criteria. It may be lower than the publish MEA along an airway or J-route segment. It may used for radar vectoring only upon the controlle determination that an adequate radar return is bei received from the aircraft being controlled. Cha depicting minimum vectoring altitudes are norma available only to the controllers and not to pilots

missed approach—

1. A maneuver conducted by a pilot when instrument approach cannot be completed to landing. The route of flight and altitude are sho on instrument approach procedure charts. A pil

executing a missed approach prior to the Missed Approach Point (MAP) must continue along the final approach to the MAP. The pilot may climb immediately to the altitude specified in the missed approach procedure.

2. A term used by the pilot to inform ATC that he is executing the missed approach.

3. At locations where ATC radar service is provided, the pilot should conform to radar vectors, when provided by ATC, in lieu of the published missed approach procedure. (See Missed Approach Point.)

MISSED APPROACH POINT (MAP)—A point prescribed in each instrument approach procedure at which a missed approach procedure shall be executed if the required visual reference does not exist. (See Missed Approach, Segments of an Instrument Approach Procedure.)

MISSED APPROACH SEGMENT—(See Segments of an Instrument Approach Procedure.)

MODE—The letter or number assigned to a specific pulse spacing of radio signals transmitted or received by ground interrogator or airborne transponder components of the Air Traffic Control Radar Beacon System (ATCRBS). Mode A (military Mode 3) and Mode C (altitude reporting) are used in air traffic control. (See Transponder, Interrogator, Radar.)

MOVEMENT AREA—The runways, taxiways, and other areas of an airport which are used for taxiing, takeoff, and landing of aircraft, exclusive of loading ramp and parking areas. At those airports with a tower, specific approval for entry onto the movement area must be obtained from ATC.

MOVING TARGET INDICATOR (MTI)—An electronic device which permits radarscope presentation only from targets which are in motion. A partial remedy for ground clutter.

NAS STAGE A—The en route ATC system's radar, computers and computer programs, controller plan view displays (PVDs/Radarscopes), input/output devices, and the related communications equipment which are integrated to form the heart of the automated IFR air traffic control system. This equipment performs flight data processing (FDP) and radar data processing (RDP). It interfaces with automated terminal systems and is used in the control of en route IFR aircraft.

NATIONAL AIRSPACE SYSTEM (NAS)—The common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information, and manpower and material. Included are system components shared jointly with the military.

NATIONAL SEARCH AND RESCUE PLAN—An interagency agreement which provides for the effective utilization of all available facilities in all types of search and rescue missions.

NAVAID CLASSES—VOR, VORTAC, and TACAN aids are classed according to their operational use. The three classes of NAVAIDs are:

T—Terminal
L—Low altitude
H—High altitude

NAVIGABLE AIRSPACE—Airspace at and above the minimum flight altitudes prescribed in the FARs including airspace needed for safe takeoff and landing. (Refer to FAR Part 91.)

NAVIGATIONAL AID/NAVAID—Any visual or electronic device airborne or on the surface which provides point-to-point guidance information or position data to aircraft in flight. (See Air Navigation Facility.)

NDB—(See Nondirectional Beacon.)

negative—"No," or "permission not granted," or "that is not correct."

negative contact—

Used by pilots to inform ATC that:

1. Previously issued traffic is not in sight. It may be followed by the pilot's request for the controller to provide assistance in avoiding the traffic.

2. They were unable to contact ATC on a particular frequency.

NIGHT—The time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time.

no gyro approach/vector—A radar approach/vector provided in case of a malfunctioning gyrocompass or directional gyro. Instead of providing the pilot with headings to be flown, the controller observes the radar track and issues control instructions "turn right/left" or "stop turn," as appropriate. (Refer to AIM.)

NONAPPROACH CONTROL TOWER—Authorizes aircraft to land or take off at the airport controlled by the tower, or to transit the airport traffic area. The primary function of a nonapproach control tower is the sequencing of aircraft in the traffic pattern and on the landing area. Nonapproach control towers also separate aircraft operating under instrument flight rule clearances from approach controls and centers. They provide ground control services to aircraft, vehicles, personnel, and equipment on the airport movement area.

NONDIRECTIONAL BEACON/RADIO BEACON (NDB)—An L/MF or UHF radio beacon transmitting nondirectional signals whereby the pilot of an aircraft equipped with direction finding equipment can determine his bearing to or from the radio beacon and "home" or on track to or from the station. When the radio beacon is installed in conjunction with the Instrument Landing System marker, it is normally called Compass Locator. (See Compass Locator, Automatic Direction Finder.)

NONPRECISION APPROACH PROCEDURE/ NONPRECISION APPROACH—A standard instrument approach procedure in which no electronic glide slope is provided; e.g., VOR, TACAN, NDB, LOC, ASR, LDA, or SDF approaches.

NONRADAR—Precedes other terms and generally means without the use of radar, such as:

1. Nonradar Route—A flight path or route over which the pilot is performing his own navigation. The pilot may be receiving radar separation, radar monitoring, or other ATC services while on a nonradar route. (See Radar Route.)

2. Nonradar Approach—Used to describe instrument approaches for which course guidance on final approach is not provided by ground based precision or surveillance radar. Radar vectors to the final approach course may or may not be provided by ATC. Examples of nonradar approaches are VOR, ADF, TACAN, and ILS approaches. (See Final Approach—IFR, Final Approach Course, Radar Approach, Instrument Approach Procedure.)

3. Nonradar Separation—The spacing of aircraft in accordance with established minima without the use of radar; e.g., vertical, lateral, or longitudinal separation. (See Radar Separation.)

4. Nonradar Arrival—An arriving aircraft that is not being vectored to the final approach course for an instrument approach or towards the airport for a visual approach. The aircraft may or may not be in a radar environment and may or may not be receiving radar separation, radar monitoring, or other servic provided by ATC. (See Radar Arrival, Radar Env ronment.)

NONRADAR APPROACH CONTROL—An AT facility providing approach control service witho the use of radar. (See Approach Control, Approa Control Service.)

nordo—(See Lost Communications.)

NOTICES TO AIRMEN/PUBLICATION—A pub cation designed primarily as a pilot's operation manual containing current NOTAM informati considered essential to the safety of flight as well supplemental data to other aeronautical publication (See Notice to Airmen (NOTAM).)

NOTICE TO AIRMEN (NOTAM)—A notice contai ing information (not known sufficiently in advan to publicize by other means) concerning the establis ment, condition, or change in any component (facilit service, or procedure of, or hazard in the Nation Airspace System), the timely knowledge of whi is essential to personnel concerned with flight oper tions.

1. NOTAM(D)—A NOTAM given (in additi to local dissemination) distant dissemination v teletypewriter beyond the area of responsibility of t Flight Service Station. These NOTAMs are stor and repeated hourly until cancelled.

2. NOTAM(L)—A NOTAM given local dissen nation by voice (teletypewriter where applicable) a a wide variety of means such as: TelAutograp teleprinter, facsimile reproduction, hot line, te copier, telegraph, and telephone to satisfy local us requirements.

3. FDC NOTAM—A notice to airmen, regulato in nature, transmitted by NFDC and given all-circ dissemination.

numerous targets vicinity (location)—A traffic a visory issued by ATC to advise pilots that targets the radarscope are too numerous to issue individual (See Traffic Advisories.)

OBSTACLE—An existing object, object of natu growth, or terrain at a fixed geographic location, which may be expected at a fixed location withi prescribed area, with reference to which verti clearance is or must be provided during fli operation.

OBSTRUCTION—An object which penetrates imaginary surface described in FAR Part 77.

OBSTRUCTION LIGHT—A light, or one of a group of lights usually red or white, frequently mounted on a surface structure or natural terrain to warn pilots of the presence of an obstruction.

OFF-ROUTE VECTOR—A vector by ATC which takes an aircraft off a previously assigned route. Altitudes assigned by ATC during such vectors provide required obstacle clearance.

OFFSET PARALLEL RUNWAYS—Staggered runways having centerlines which are parallel.

on course—

1. Used to indicate that an aircraft is established on the route centerline.

2. Used by ATC to advise a pilot making a radar approach that his aircraft is lined up on the final approach course.

OPTION APPROACH—An approach requested and conducted by a pilot which results in either a touch-and-go, missed approach, low approach, stop-and-go, or full-stop landing. (See Cleared for the Option.)

out—The conversation is ended and no response is expected.

OUTER COMPASS LOCATOR—(See Compass Locator.)

OUTER FIX—A general term used within ATC to describe fixes in the terminal area, other than the final approach fix. Aircraft are normally cleared to these fixes by an Air Route Traffic Control Center or an Approach Control Facility. Aircraft are normally cleared from these fixes to the final approach fix or final approach course.

OUTER MARKER (OM)—A marker beacon at or near the glide slope intercept altitude of an ILS approach. It is keyed to transmit two dashes per second on a 400 Hz tone which is received aurally and visually by compatible airborne equipment. The OM is normally located 4 to 7 miles from the runway threshold on the extended centerline of the runway. (See Marker Beacon, Instrument Landing System.)

over—My transmission is ended; I expect a response.

OVERHEAD APPROACH/360 OVERHEAD—A series of predetermined maneuvers prescribed for VFR arrival of military aircraft (often in formation) for entry into the VFR traffic pattern and to proceed to a landing. The pattern usually specifies the following:

1. The radio contact required of the pilot.
2. The speed to be maintained.
3. An initial approach 3 to 5 miles in length.
4. An elliptical pattern consisting of two 180° turns.
5. A break point at which the first 180° turn is started.
6. The direction of turns.
7. Altitude (at least 500 feet above the conventional pattern.)
8. A "Roll-out" on final approach not less than 1/4 mile from the landing threshold and not less than 300 feet above the ground.

pan—The international radio-telephony urgency signal. When repeated three times indicates uncertainly or alert, followed by nature of urgency. (See MAYDAY.)

PARALLEL OFFSET ROUTE—A parallel track to the left or right of the designated or established airway/route. Normally associated with Area Navigation (RNAV) operations. (See Area Navigation.)

PARALLEL RUNWAYS—Two or more runways at the same airport whose centerlines are parallel. In addition to runway number, parallel runways are designated as L (left) and R (right) or, if three parallel runways exist L (left), C (center), and R (right).

PERMANENT ECHO—Radar signals reflected from fixed objects on the earth's surface—e.g., buildings, towers, terrain. Permanent echoes are distinguished from "ground clutter" by being definable locations rather than large areas. Under certain conditions they may be used to check radar alignment.

PILOT IN COMMAND—The pilot responsible for the operation and safety of an aircraft during flight time. (Refer to FAR Part 91.)

pilot's discretion—When used in conjunction with altitude assignments, means that ATC has offered the pilot the option of starting climb or descent whenever he wishes and conducting the climb or descent at any rate he wishes. He may temporarily level off at any intermediate altitude. However, once he has vacated an altitude he may not return to that altitude.

PILOT WEATHER REPORT (PIREP)—A report of meteorological phenomena encountered by aircraft in flight.

POSITION REPORT/PROGRESS REPORT—A report over a known location as transmitted by an aircraft to ATC.

POSITIVE CONTROL—The separation of all air traffic, within designated airspace, by air traffic control. (See Positive Control Area.)

POSITIVE CONTROL AREA (PCA)—(See Controlled Airspace.)

PRACTICE INSTRUMENT APPROACH—An instrument approach procedure conducted by a VFR or IFR aircraft for the purpose of pilot training or proficiency demonstrations.

PRECIPITATION—Any or all forms of water particles (rain, sleet, hail, or snow) that fall from the atmosphere and reach the surface.

PRECISION APPROACH PROCEDURE/PRECISION APPROACH—A standard instrument approach procedure in which an electronic glide slope is provided, e.g., ILS and PAR. (See Instrument Landing System, Precision Approach Radar.)

PRECISION APPROACH RADAR (PAR)—Radar equipment in some ATC facilities operated by the FAA, and/or the military services at joint-use civil/military locations and separate military installations, to detect and display azimuth, elevation, and range of aircraft on the final approach course to a runway. This equipment may be used to monitor certain nonradar approaches, but is primarily used to conduct a precision instrument approach (PAR) wherein the controller issues guidance instructions to the pilot, based on the aircraft's position in relation to the final approach course (azimuth), the glidepath (elevation), and the distance (range) from the touchdown point on the runway as displayed on the radarscope. (See Glide Slope.)

The abbreviation "PAR" is also used to denote preferential arrival routes in ARTCC computers. (See Preferential Routes.)

PREVAILING VISIBILITY—(See Visibility.)

PROCEDURE TURN INBOUND—That point of a procedure turn maneuver where course reversal has been completed and an aircraft is established inbound on the intermediate approach segment or final approach course. A report of "procedure tu inbound" is normally used by ATC as a positi report for separation purposes. (See Final Approa Course; Procedure Turn; Segments of an Instrume Approach Procedure.)

PROCEDURE TURN (PT)—The maneuver pr scribed when it is necessary to reverse direction establish an aircraft on the intermediate approa segment or final approach course. The outbou course, direction of turn, distance within which t turn must be completed, and minimum altitude a specified in the procedure. However, unless othe wise restricted, the point at which the turn may commenced, and the type and rate of turn, are left the discretion of the pilot.

PROFILE DESCENT—An uninterrupted desce (except where level flight is required for speed adju ment—e.g., 250 knots at 10,000 feet MSL) fro cruising altitude/level to interception of a glide slo or to a minimum altitude specified for the initial intermediate approach segment of a nonprecisi instrument approach. The profile descent normal terminates at the approach gate or where the gli slope or other appropriate minimum altitude intercepted.

PUBLISHED ROUTE—A route for which an IF altitude has been established and published—e. Federal airways, Jet routes, area navigation rout specified direct routes.

QUADRANT—A quarter part of a circle, center on a NAVAID, oriented clockwise from magne north as follows: NE quadrant 000-089, SE qua rant 090-179, SW quadrant 180-269, NW quadra 270-359.

QUICK LOOK—A feature of NAS Stage A a ARTS which provides the controller the capability display full data blocks of tracked aircraft fr other control positions.

RADAR (RADIO DETECTING AND RANGING) A device which, by measuring the time inter between transmission and reception of radio pul and correlating the angular orientation of the radiat antenna beam or beams in azimuth and/or elevati provides information on range, azimuth, and/ elevation of objects in the path of the transmitt pulses.

1. Primary Radar—A radar system in which minute portion of a radio pulse transmitted from site is reflected by an object and then received ba

at that site for processing and display at an air traffic control facility.

2. Secondary Radar/Radar Beacon/ATCRBS—A radar system in which the object to be detected is fitted with cooperative equipment in the form of a radio receiver/transmitter (transponder). Radar pulses transmitted from the searching transmitter/receiver (interrogator) site are received in the cooperative equipment and used to trigger a distinctive transmission from the transponder. This reply transmission, rather than a reflected signal, is then received back at the transmitter/receiver site for processing and display at an air traffic control facility. (See Transponder, Interrogator.)

RADAR ADVISORY—The provision of advice and information based on radar observations. (See Advisory Service.)

RADAR APPROACH—An instrument approach procedure which utilizes Precision Approach Radar (PAR) or Airport Surveillance Radar (ASR). (See PAR Approach, Surveillance Approach, Airport Surveillance Radar, Precision Approach Radar, Instrument Approach Procedure.)

RADAR APPROACH CONTROL FACILITY—A terminal ATC facility that uses radar and nonradar capabilities to provide approach control services to aircraft arriving, departing, or transiting airspace controlled by the facility (see Approach Control Service). Provides radar ATC services to aircraft operating in the vicinity of one or more civil and/or military airports in a terminal area. The facility may provide services of a ground controlled approach (GCA), i.e., ASR and PAR approaches. A radar approach control facility may be operated by FAA, USAF, US Army, USN, USMC, or jointly by FAA and a military service. Specific facility nomenclature is used for administrative purposes only and is related to the physical location of the facility and the operating service generally as follows:

Army Radar Approach Control (ARAC)—Army.

Radar Air Traffic Control Facility (RATCF)—Navy/FAA.

Radar Approach Control (RAPCON)—Air Force/FAA.

Terminal Radar Approach Control (TRACON)—FAA.

Tower/Airport Traffic Control Tower (ATCT)—FAA.

(Only those towers delegated approach control authority.)

RADAR BEACON—(See Radar.)

radar contact—

1. Used by ATC to inform an aircraft that it is identified on the radar display and that radar flight following will be provided until radar identification is terminated. Radar service may also be provided within the limits of necessity and capability. When a pilot is informed of "radar contact," he automatically discontinues reporting over compulsory reporting points. (See Radar Flight Following, Radar Contact Lost, Radar Service, Radar Service Terminated.)

2. A term used to inform the controller initiating a handoff that the aircraft is identified and approval is granted for the aircraft to enter the receiving controller's airspace.

radar contact lost—Used by ATC to inform a pilot that radar identification of his aircraft has been lost. The loss may be attributed to several things including the aircraft merging with weather or ground clutter, the aircraft flying below radar line of sight, the aircraft entering an area of poor radar return, or a failure of the aircraft transponder or ground radar equipment. (See Clutter, Radar Contact.)

RADAR ENVIRONMENT—An area in which radar service may be provided. (See Radar Contact, Radar Service, Additional Services, Traffic Advisories.)

RADAR IDENTIFICATION—The process of ascertaining that an observed radar target is the radar return from a particular aircraft. (See Radar Contact, Radar Service.)

RADAR IDENTIFIED AIRCRAFT—An aircraft, the position of which has been correlated with an observed target or symbol on the radar display. (See Radar Contact, Radar Contact Lost.)

RADAR POINT OUT/POINT OUT—Used between controllers to indicate radar handoff action where the initiating controller plans to retain communications with an aircraft penetrating the other controller's airspace and additional coordination is required.

RADAR ROUTE—A flight path or route over which an aircraft is vectored. Navigational guidance and altitude assignments are provided by ATC. (See Flightpath, Route.)

RADAR SEPARATION—(See Radar Service.)

RADAR SERVICE—A term which encompasses one or more of the following services based on the use of

radar which can be provided by a controller to a pilot of a radar identified aircraft.

1. Radar Separation—Radar spacing of aircraft in accordance with established minima.

2. Radar Navigational Guidance—Vectoring aircraft to provide course guidance.

3. Radar Monitoring—The radar flight following of aircraft, whose primary navigation is being performed by the pilot, to observe and note deviations from its authorized flightpath, airway, or route. When being applied specifically to radar monitoring of instrument approaches, i.e., with precision approach radar (PAR) or radar monitoring of simultaneous ILS approaches, it includes advice and instructions whenever an aircraft nears or exceeds the prescribed PAR safety limit or simultaneous ILS no-transgression zone. (See Additional Services, Traffic Advisories.)

radar service terminated—Used by ATC to inform a pilot that he will no longer be provided any of the services that could be received while under radar contact. Radar service is automatically terminated and the pilot is not advised in the following cases:

1. An aircraft cancels its IFR flight plan, except within a TCA, TRSA, or where Stage II service is provided.

2. At the completion of a radar approach.

3. When an arriving VFR aircraft, receiving radar services, is advised to contact the tower.

4. When an aircraft conducting a visual approach or contact approach is advised to contact the tower.

5. When an aircraft making an instrument approach has landed or the tower has the aircraft in sight, whichever occurs first.

RADAR SURVEILLANCE—The radar observation of a given geographical area for the purpose of performing some radar function.

RADAR TRAFFIC ADVISORIES—(See Traffic Advisories.)

RADAR TRAFFIC INFORMATION SERVICE—(See Traffic Advisories.)

RADAR WEATHER ECHO INTENSITY LEVELS—Existing radar systems cannot detect turbulence. However, there is a direct correlation between the degree of turbulence and other weather features associated with thunderstorms and the radar weather echo intensity. The National Weather Service ha categorized six (6) levels of radar weather ech intensity. The following list gives the weather feature likely to be associated with these levels durin thunderstorm weather situations.

1. Level 1 (WEAK) and Level 2 (MODERATE) Light to moderate turbulence is possible, wit lightning.

2. Level 3 (STRONG). Severe turbulence possible lightning.

3. Level 4 (VERY STRONG). Severe turbulenc likely; lightning.

4. Level 5 (INTENSE). Severe turbulence; light ning; organized wind gusts. Hail likely.

5. Level 6 (EXTREME). Severe turbulence; larg hail; lightning; extensive wind gusts; and turbulence

RADIAL—A magnetic bearing extending from VOR/VORTAC/TACAN navigation facility.

RADIO ALTIMETER/RADAR ALTIMETER—Ai craft equipment which makes use of the reflection c radio waves from the ground to determine the heigh of the aircraft above the surface.

RADIO BEACON—(See Nondirectional Beacon.)

RADIO MAGNETIC INDICATOR/RMI—An ai craft navigational instrument coupled with a gyr compass or similar compass that indicates the direc tion of a selected NAVAID and indicates bearin with respect to the heading of the aircraft.

RAMP—(See Apron.)

read back—Repeat my message back to me.

RECEIVING CONTROLLER/FACILITY—A cor troller/facility receiving control of an aircraft fro another controller/facility.

reduce speed to (speed)—(See Speed Adjustment.)

RELEASE TIME—A departure time restriction issue to a pilot by ATC when necessary to separate departing aircraft from the other traffic.

report—Used to instruct pilots to advise ATC c specified information, e.g., "Report passing Hamiltc VOR."

REPORTING POINT—A geographical location i relation to which the position of an aircraft reported. (See Compulsory Reporting Point.)

request full route clearance (FRC)—Used by pilots to request that the entire route of flight be read verbatim in an ATC clearance. Such request should be made to preclude receiving an ATC clearance based on the original filed flight plan when a filed IFR flight plan has been revised by the pilot, company, or operations prior to departure.

RESCUE COORDINATION CENTER (RCC)—A search and rescue (SAR) facility equipped and manned to coordinate and control SAR operations in an area designated by the SAR plan. The U.S. Coast Guard and the U.S. Air Force have responsibility for the operation of RCCs.

RESTRICTED AREA—(See Special Use Airspace.)

resume own navigation—Used by ATC to advise a pilot to resume his own navigational responsibility. It is issued after completion of a radar vector or when radar contact is lost while the aircraft is being radar vectored. (See Radar Contact Lost, Radar Service Terminated.)

RNAV—(See Area Navigation.)

RNAV APPROACH—An instrument approach procedure which relies on aircraft area navigation equipment for navigational guidance. (See Instrument Approach Procedure, Area Navigation.)

roger—I have received all of your last transmission. It should not be used to answer a question requiring a yes or no answer. (See Affirmative, Negative.)

ROLLOUT RVR—(See Visibility.)

ROUTE—A defined path, consisting of one or more courses in a horizontal plane, which aircraft traverse over the surface of the earth. (See Airway, Jet Route, Published Route, Unpublished Route.)

ROUTE SEGMENT—As used in Air Traffic Control, a part of a route that can be defined by two navigational fixes, two NAVAIDs, or a fix and a NAVAID. (See Fix, Route.)

RUNWAY—A defined rectangular area, on a land airport prepared for the landing and takeoff run of aircraft along its length. Runways are normally numbered in relation to their magnetic direction rounded off to the nearest 10°, e.g., Runway 01, Runway 25. (See Parallel Runways.)

RUNWAY CENTERLINE LIGHTING—(See Airport Lighting.)

RUNWAY CONDITION READING (RCR)—Numerical decelerometer readings relayed by air traffic controllers at USAF and certain civil bases for use by the pilot in determining runway braking action. These readings are routinely relayed only to USAF and Air National Guard aircraft. (See Braking Action.)

RUNWAY END IDENTIFIER LIGHTS—(See Airport Lighting.)

RUNWAY IN USE/ACTIVE RUNWAY/DUTY RUNWAY—Any runway or runways currently being used for takeoff or landing. When multiple runways are used, they are all considered active runways.

RUNWAY LIGHTS—(See Airport Lighting.)

RUNWAY USE PROGRAM—A noise abatement runway selection plan designed to enhance noise abatement efforts with regard to airport communities for arriving and departing aircraft. These plans are developed into runway use programs and apply to all turbojet aircraft 12,500 pounds or heavier; turbojet aircraft less than 12,500 pounds are included only if the airport proprietor determines that the aircraft creates a noise problem. Runway use programs are coordinated with FAA offices, and safety criteria used in these programs are developed by the Office of Flight Operations. Runway use programs are administered by the Air Traffic Service as "Formal" or "Informal" programs.

1. Formal Runway Use Program An approved noise abatement program which is defined and acknowledged in a Letter of Understanding between Flight Standards, Air Traffic Service, the airport proprietor, and the users. Once established, participation in the program is mandatory for aircraft operators and pilots as provided for in FAR Section 91.87.
2. Informal Runway Use Program. An approved noise abatement program which does not require a Letter of Understanding, and participation in the program is voluntary for aircraft operators/pilots.

RUNWAY VISIBILITY VALUE (RVV)—(See Visibility.)

RUNWAY VISUAL RANGE (RVR)—(See Visibility.)

SAFETY ADVISORY—A safety advisory issued by ATC to aircraft under their control if ATC is aware the aircraft is at an altitude which, in the controller's judgment, places the aircraft in unsafe proximity to terrain, obstructions, or other aircraft. The controller may discontinue the issuance of further advisories if

the pilot advises he is taking action to correct the situation or has the other aircraft in sight.

1. Terrain/Obstruction Advisory—A safety advisory issued by ATC to aircraft under their control if ATC is aware the aircraft is at an altitude which, in the controller's judgment, places the aircraft in unsafe proximity to terrain/obstructions, e.g., "Low Altitude Alert, check your altitude immediately."

2. Aircraft Conflict Advisory—A safety advisory issued by ATC to aircraft under their control if ATC is aware of an aircraft that is not under their control at an altitude which, in the controller's judgment, places both aircraft in unsafe proximity to each other. With the alert, ATC offers the pilot an alternate course of action when feasible, e.g., "Traffic Alert, advise you turn right heading zero niner zero or climb to eight thousand immediately."

The issuance of a safety advisory is contingent upon the capability of the controller to have an awareness of an unsafe condition. The course of action provided is predicated on other traffic under ATC control. Once the advisory is issued, it is solely the pilot's prerogative to determine what course of action, if any, he will take.

say again—Used to request a repeat of the last transmission. Usually specifies transmission or portion thereof not understood or received, e.g., "Say again all after ABRAM VOR."

say altitude—Used by ATC to ascertain an aircraft's specific altitude/flight level. When the aircraft is climbing or descending, the pilot should state the indicated altitude rounded to the nearest 100 feet.

say heading—Used by ATC to request an aircraft's heading. The pilot should state the actual heading of the aircraft.

SEALANE—A designated portion of water, outlined by visual surface markers, for and intended to be used by aircraft designed to operate on water.

SEARCH AND RESCUE FACILITY—A facility responsible for maintaining and operating a search and rescue (SAR) service to render aid to persons and property in distress. It is any SAR unit, station, NET or other operational activity which can be usefully employed during an SAR Mission, e.g., a Civil Air Patrol Wing or a Coast Guard Station. (See Search and Rescue.)

SEARCH AND RESCUE (SAR)—A service which seeks missing aircraft and assists those found to be in need of assistance. It is a cooperative effort using the facilities and service of available Federal, state, and local agencies. The U.S. Coast Guard is responsible for coordination of search and rescue for the Maritime Region and the U.S. Air Force is responsible for search and rescue for the Inland Region. Information pertinent to search and rescue should be passed through any air traffic facility or be transmitted directly to the Rescue Coordination Center by telephone. (See Flight Service Station, Rescue Coordination Center.)

SEE AND AVOID—A visual procedure wherein pilots of aircraft flying in visual meteorological conditions (VMC), regardless of type of flight plan, are charged with the responsibility to observe the presence of other aircraft and to maneuver their aircraft as required to avoid the other aircraft. Right-of-way rules are contained in FAR Part 91. (See Instrument Flight Rules, Visual Flight Rules, Visual Meteorological Conditions, Instrument Meteorological Conditions.)

SEGMENTED CIRCLE—A system of visual indicators designed to provide traffic pattern information at airports without operating control towers.

SEGMENTS OF AN INSTRUMENT APPROACH PROCEDURE—An instrument approach procedure may have as many as four separate segments, depending on how the approach procedure is structured.

1. Initial Approach—The segment between the initial approach fix and the intermediate fix or the point where the aircraft is established on the intermediate course or final approach course.

2. Intermediate Approach—The segment between the intermediate fix or point and the final approach fix.

3. Final Approach—The segment between the final approach fix or point and the runway, airport, or missed approach point.

4. Missed Approach—The segment between the missed approach point, or point of arrival at decision height, and the missed approach fix at the prescribed altitude.

SEPARATION—In air traffic control, the spacing of aircraft to achieve their safe and orderly movement in flight and while landing and taking off. (See Separation Minima.)

SEPARATION MINIMA—The minimum longitudinal, lateral, or vertical distances by which aircraft are spaced through the application of air traffic control procedures. (See Separation.)

SEVERE WEATHER AVOIDANCE PLAN (SWAP)—A plan to reroute traffic to avoid severe weather in the New York ARTCC area to provide the least disruption to the ATC system when large portions of airspace are unusable due to severe weather.

SHORT RANGE CLEARANCE—A clearance issued to a departing IFR flight which authorizes IFR flight to a specific fix short of the destination while air traffic control facilities are coordinating and obtaining the complete clearance.

SHORT TAKEOFF AND LANDING AIRCRAFT (STOL AIRCRAFT)—An aircraft which, at some weight within its approved operating weight, is capable of operating from an STOL runway in compliance with the applicable STOL characteristics, airworthiness, operations, noise, and pollution standards. (See Vertical Takeoff and Landing Aircraft.)

SIDESTEP MANEUVER—A visual maneuver accomplished by a pilot at the completion of an instrument approach, to permit a straight-in landing on a parallel runway not more than 1,200 feet to either side of the runway to which the instrument approach was conducted.

SIGNIFICANT METEOROLOGICAL INFORMATION (SIGMET)—A weather advisory issued concerning weather significant to the safety of all aircraft. SIGMET advisories cover severe and extreme turbulence, severe icing, and widespread dust or sandstorms that reduce visibility to less than 3 miles. (See AIRMET, Convective SIGMET.)

SIMULTANEOUS ILS APPROACHES—An approach system permitting simultaneous ILS approaches to airports having parallel runways separated by at least 4,300 feet between centerlines. Integral parts of a total system are ILS, radar, communications, ATC procedures, and appropriate airborne equipment. (See Parallel Runways.)

SINGLE FREQUENCY APPROACH (SFA)—A service provided under a Letter of Agreement, to military single-piloted turbojet aircraft which permits use of a single UHF frequency during approach for landing. Pilots are normally not required to change frequency from the beginning of the approach to touchdown, except that pilots conducting an en route descent are required to change frequency when control is transferred from the air route traffic control center to the terminal facility. The abbreviation "SFA" in the DOD FLIP IFR Supplement under "Communications" indicates this service is available at an aerodrome.

SINGLE-PILOTED AIRCRAFT—A military turbojet aircraft possessing one set of flight controls, tandem cockpits, or two sets of flight controls but operated by one pilot is considered "single-piloted" by ATC when determining the appropriate air traffic service to be applied. (See Single Frequency Approach.)

SLASH—A radar beacon reply displayed as an elongated target.

speak slower—Used in verbal communications as a request to reduce speech rate.

SPECIAL EMERGENCY—A condition of air piracy or other hostile act by a person(s) aboard an aircraft, which threatens the safety of the aircraft or its passengers.

SPECIAL IFR—(See Fixed-Wing Special IFR.)

SPECIAL INSTRUMENT APPROACH PROCEDURE—(See Instrument Approach Procedure.)

SPECIAL USE AIRSPACE—Airspace of defined dimensions identified by an area on the surface of the earth wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon aircraft operations that are not a part of those activities.

TYPES OF SPECIAL USE AIRSPACE:

1. Alert Area—Airspace which may contain a high volume of pilot training activities or an unusual type of aerial activity, neither of which is hazardous to aircraft. Alert areas are depicted on aeronautical charts for the information of nonparticipating pilots. All activities within an Alert area are conducted in accordance with Federal Aviation Regulations, and pilots of participating aircraft as well as pilots transiting the area are equally responsible for collision avoidance.

2. Controlled Firing Area—Airspace wherein activities are conducted under conditions so controlled as to eliminate hazards to nonparticipating aircraft and to ensure the safety of persons and property on the ground.

3. Military Operations Area (MOA)—An MOA is an airspace assignment of defined vertical and lateral dimensions established outside positive control areas to separate/segregate certain military activities from IFR traffic and to identify for VFR traffic where these activities are conducted.

4. Prohibited Area—Designated airspace within which the flight of aircraft is prohibited. (Refer to En Route Charts.)

5. Restricted Area—Airspace designated under FAR Part 73, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Most restricted areas are designated joint use, and IFR/VFR operations in the area may be authorized by the controlling ATC facility when it is not being utilized by the using agency. Restricted areas are depicted on en route charts. Where joint use is authorized, the name of the ATC controlling facility is also shown.

6. Warning Area—Airspace which may contain hazards to nonparticipating aircraft in international airspace.

SPECIAL VFR CONDITIONS—Weather conditions in a control zone which are less than basic VFR and in which some aircraft are permitted flight under Visual Flight Rules. (See Special VFR Operations.) (Refer to FAR Part 91.)

SPECIAL VFR OPERATIONS—Aircraft operating in accordance with clearances within control zones in weather conditions less than the basic VFR weather minima. Such operations must be requested by the pilot and approved by ATC. (See Special VFR Conditions.)

SPEED—(See Airspeed, Groundspeed.)

SPEED ADJUSTMENT—An ATC procedure used to request pilots to adjust aircraft speed to a specific value for the purpose of providing desired spacing. Pilots are expected to maintain a speed of plus or minus 10 knots or 0.02 mach number of the specified speed.

Examples of Speed Adjustments are:

1. "Increase/reduce speed to mach point (number)."
2. "Increase/reduce speed to (speed in knots)," or "Increase/reduce speed (number of knots) knots."
3. "If practical, reduce speed to (speed)," or "If practical, reduce speed (number of) knots."

SPEED BRAKES/DIVE BRAKES—Movable aerodynamic devices on aircraft that reduce airspeed during descent and landing.

squawk (mode, code, function)—Activate specific modes/codes/functions on the aircraft transponder, e.g., "Squawk three/alpha, two one zero five, low." (See Transponder.)

STAGE I/II/III SERVICE—(See Terminal Radar Program.)

STANDARD INSTRUMENT APPROACH PROCEDURE—(See Instrument Approach Procedure.)

STANDARD INSTRUMENT DEPARTURE (SID)—A preplanned instrument flight rule (IFR) air traffic control departure procedure printed for pilot use in graphic and/or textual form. SIDs provide transition from the terminal to the appropriate en route structure.

STANDARD RATE TURN—A turn of 3° per second.

STANDARD TERMINAL ARRIVAL (STAR)—A preplanned instrument flight rule (IFR) air traffic control arrival procedure published for pilot use in graphic and/or textual form. STARs provide transition from the en route structure to an outer fix or an instrument approach fix/arrival waypoint in the terminal area.

stand by—Means the controller or pilot must pause for a few seconds, usually to attend to other duties of a higher priority. Also means to wait as in "stand by for clearance." If a delay is lengthy, the caller should reestablish contact.

STATIONARY RESERVATIONS—Altitude reservations which encompass activities in a fixed area. Stationary reservations may include activities such as special tests of weapons systems or equipment; certain U.S. Navy carrier, fleet, and anti-submarine operations; rocket, missile, and drone operations; and certain aerial refueling or similar operations.

STEPDOWN FIX—A fix permitting additional descent within a segment of an instrument approach procedure by identifying a point at which a controlling obstacle has been safely overflown.

stop altitude squawk—Used by ATC to inform an aircraft to turn off the automatic altitude reporting feature of its transponder. It is issued when the verbally reported altitude varies 300 feet or more from the automatic altitude report. (See Altitude Readout, Transponder.)

STOP AND GO—A procedure wherein an aircraft lands, makes a complete stop on the runway, and then commences a takeoff from that point. (See Low Approach, Option Approach.)

STOPOVER FLIGHT PLAN—A flight plan which includes two or more separate en route flight segments with a stopover at one or more intermediate airports.

stop squawk (Mode or Code)—Used by ATC to tell the pilot to turn specified functions of the aircraft transponder off. (See Stop Altitude Squawk, Transponder.)

stop stream/burst/buzzer—Used by ATC to request a pilot to suspend electronic countermeasure activity. (See Jamming.)

STRAIGHT-IN APPROACH—IFR—An instrument approach wherein final approach is begun without first having executed a procedure turn, not necessarily completed with a straight-in landing or made to straight-in landing minimums. (See Straight-in Landing, Landing Minimums, Straight-in Approach—VFR.)

STRAIGHT-IN APPROACH—VFR—Entry into the traffic pattern by interception of the extended runway centerline (final approach course) without executing any other portion of the traffic pattern. (See Traffic Pattern.)

STRAIGHT-IN LANDING—A landing made on a runway aligned within 30° of the final approach course following completion of an instrument approach. (See Straight-in Approach—IFR.)

STRAIGHT-IN LANDING MINIMUMS/ STRAIGHT-IN MINIMUMS—(See Landing Minimums.)

SUBSTITUTE ROUTE—A route assigned to pilots when any part of an airway or route is unusable because of NAVAID status. These routes consist of:

1. Substitute routes which are shown on U.S. Government charts.
2. Routes defined by ATC as specific NAVAID radials or courses.
3. Routes defined by ATC as direct to or between NAVAIDs.

SUNSET AND SUNRISE—The mean solar times of sunset and sunrise as published in the *Nautical Almanac*, converted to local standard time for the locality concerned. Within Alaska, the end of evening civil twilight and the beginning of morning civil twilight, as defined for each locality.

SURVEILLANCE APPROACH—An instrument approach wherein the air traffic controller issues instructions for pilot compliance based on aircraft position in relation to the final approach course (azimuth) and the distance (range) from the end of the runway as displayed on the controller's radarscope. The controller will provide recommended altitudes on final approach if requested by the pilot. (See PAR Approach.)

TACAN-ONLY AIRCRAFT—An aircraft, normally military, possessing TACAN with DME but no VOR navigational system capability. Clearances must specify TACAN or VORTAC fixes and approaches.

TACTICAL AIR NAVIGATION (TACAN)—An ultrahigh frequency electronic *rho-theta* air navigation aid which provides suitably equipped aircraft a continuous indication of bearing and distance to the TACAN station. (See VORTAC.)

TARGET—The indication shown on a radar display, resulting from a primary radar return or a radar beacon reply. (See Radar, Target Symbol.)

TARGET SYMBOL—A computer-generated indication shown on a radar display, resulting from a primary radar return or a radar beacon reply.

TAXI—The movement of an airplane under its own power on the surface of an airport (FAR Part 135.100 Note). Also, it describes the surface movement of helicopters equipped with wheels. (See Air Taxi, Hover Taxi.)

taxi into position and hold—Used by ATC to inform a pilot to taxi onto the departure runway in takeoff position and hold. It is not authorization for takeoff. It is used when takeoff clearance cannot immediately be issued because of traffic or other reasons. (See Hold, Cleared for Takeoff.)

TAXI PATTERNS—Patterns established to illustrate the desired flow of ground traffic for the different runways or airport areas available for use.

TERMINAL AREA—A general term used to describe airspace in which approach control service or airport traffic control service is provided.

TERMINAL AREA FACILITY—A facility providing air traffic control service for arriving and departing IFR, VFR, Special VFR, Special IFR aircraft, and, on occasion, en route aircraft. (See Approach Control, Tower.)

TERMINAL CONTROL AREA—(See Controlled Airspace)

TERMINAL RADAR PROGRAM—A national program instituted to extend the terminal radar services provided IFR aircraft, to VFR aircraft. Pilot participation in the program is urged but is not mandatory. The program is divided into two parts, referred to as Stage II and Stage III. The stage service provided at a particular location is contained in an Airport/Facility Directory.

1. Stage I originally comprised two basic radar services (traffic advisories and limited vectoring to VFR aircraft). These services are provided by all commissioned terminal radar facilities, but the term "Stage I" has been deleted from use.
2. Stage II/Radar Advisory and Sequencing for VFR Aircraft—provides, in addition to the basic radar services, vectoring and sequencing on a full-time basis to arriving VFR aircraft. The purpose is to adjust the flow of arriving IFR and VFR aircraft into the traffic pattern in a safe and orderly manner and to provide traffic advisory to departing VFR aircraft.
3. Stage III/Radar Sequencing and Separation Service for VFR Aircraft—provides, in addition to the basic radar services and Stage II, separation between all participating VFR aircraft. The purpose is to provide separation between all participating VFR aircraft and all IFR aircraft operating within the airspace defined as a Terminal Radar Service Area (TRSA) or Terminal Control Area (TCA). (See Controlled Airspace, Terminal Radar Service Area.)

TERMINAL RADAR SERVICE AREA (TRSA)—Airspace surrounding designated airports wherein ATC provides radar vectoring, sequencing, and separation on a full-time basis for all IFR and participating VFR aircraft. Service provided in a TRSA is called Stage III Service. AIM contains an explanation of TRSA. TRSAs are depicted on VFR aeronautical charts. Pilot participation is urged but is not mandatory. (See Terminal Radar Program.)

TERRAIN FOLLOWING (TF)—The flight of a military aircraft maintaining a constant AGL altitude above the terrain or the highest obstruction. The altitude of the aircraft constantly changes with the varying terrain and/or obstruction.

TETRAHEDRON—A device normally located on uncontrolled airports and used as a landing direction indicator. The small end of a tetrahedron points in the direction of landing. At controlled airports, the tetrahedron, if installed, should be disregarded because tower instructions supersede the indicator. (See Segmented Circle.)

that is correct—The understanding you have is right.

THRESHOLD—The beginning of that portion of the runway usable for landing. (See Airport Lighting, Displaced Threshold.)

THRESHOLD CROSSING HEIGHT (TCH)—The height of the glide slope above the runway threshold. (See Glide Slope, Threshold.)

THRESHOLD LIGHTS—(See Airport Lighting.)

TIME GROUP—Four digits representing the hour and minutes from the 24-hour clock. Time group without time zone indicators is understood to be GMT (Greenwich Mean Time), e.g., "0205." The end and beginning of the day are shown by "2400" and "0000," respectively.

TOUCH AND GO/TOUCH AND GO LANDING—An operation by an aircraft that lands and departs on a runway without stopping or exiting the runway.

TOUCHDOWN—

1. The point at which an aircraft first makes contact with the landing surface.

2. Concerning a precision radar approach (PAR), it is the point where the glide path intercepts the landing surface.

TOUCHDOWN RVR—(See Visibility.)

TOUCHDOWN ZONE—The first 3,000 feet of the runway, beginning at the threshold. The area is used for determination of Touchdown Zone Elevation in the development of straight-in landing minimums for instrument approaches.

TOUCHDOWN ZONE ELEVATION (TDZE)—The highest elevation in the first 3,000 feet of the landing surface. TDZE is indicated on the instrument approach procedure chart when straight-in landing minimums are authorized. (See Touchdown Zone.)

TOUCHDOWN ZONE LIGHTING—(See Airport Lighting.)

TOWER/AIRPORT TRAFFIC CONTROL TOWER—A terminal facility that uses air/ground radio communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport or on the movement area. Authorizes aircraft to land or take off at the airport controlled by the tower or to transit the airport

traffic area regardless of flight plan or weather conditions (IFR or VFR). A tower may also provide approach control services (radar or nonradar). (See Airport Traffic Area, Airport Traffic Control Service, Approach Control/Approach Control Facility, Approach Control Service, Movement Area, Tower En Route Control Service/Tower to Tower.)

TOWER EN ROUTE CONTROL SERVICE/ TOWER TO TOWER—The control of IFR en route traffic within delegated airspace between two or more adjacent approach control facilities. This service is designed to expedite traffic and reduce control and pilot communication requirements.

TPX 42—A numeric beacon decoder equipment/ system. It is designed to be added to terminal radar systems for beacon decoding. It provides rapid target identification, reinforcement of the primary radar target, and altitude information from Mode C. (See Automated Radar Terminal Systems, Transponder.)

TRACK—The actual flight path of an aircraft over the surface of the earth. (See Course, Route, Flightpath.)

TRAFFIC—

1. A term used by a controller to transfer radar identification of an aircraft to another controller, for the purpose of coordinating separation action. Traffic is normally issued (a) in response to a handoff or point out, (b) in anticipation of a handoff or point out, or (c) in conjunction with a request for control of an aircraft.
2. A term used by ATC to refer to one or more aircraft.

(identification), **traffic alert. Advise you turn left/right** (specific heading if appropriate), **and/or climb/descend** (specific altitude if appropriate) **immediately**— (See Safety Advisory.)

TRAFFIC ADVISORIES—Advisories issued to alert a pilot to other known or observed air traffic which may be in such proximity to his aircraft's position or intended route of flight as to warrant his attention. Such advisories may be based on:

1. Visual observation from a control tower.
2. Observation of radar identified and nonidentified aircraft targets on an ATC radar display, or
3. Verbal reports from pilots or other facilities.

Controllers use the word (traffic) followed by additional information, if known, to provide such advisories, e.g., "Traffic, 2 o'clock, one zero miles, southbound, fast moving, eight thousand."

Traffic advisory service will be provided to the extent possible depending on higher priority duties of the controller or other limitations, e.g., radar limitations, volume of traffic, frequency congestion, or controller workload. Radar/nonradar traffic advisories do not relieve the pilot of his responsibility to see and avoid other aircraft. Pilots are cautioned that there are many times when the controller is not able to give traffic advisories concerning all traffic in the aircraft's proximity; in other words, when a pilot requests or is receiving traffic advisories, he should not assume that all traffic will be issued. (Refer to AIM, Radar Traffic Information Service.)

traffic in sight—Used by pilots to inform a controller that previously issued traffic is in sight. (See Negative Contact; Traffic Advisories.)

traffic no longer a factor—Indicates that the traffic described in a previously issued traffic advisory is no longer a factor.

TRAFFIC PATTERN—The traffic flow that is prescribed for aircraft landing at, taxiing on, or taking off from an airport. The components of a typical traffic pattern are upwind leg, crosswind leg, downwind leg, base leg, and final approach.

1. Upwind Leg—A flightpath parallel to the landing runway in the direction of landing.
2. Crosswind Leg—A flightpath at right angles to the landing runway off its upwind end.
3. Downwind Leg—A flightpath parallel to the landing runway in the direction opposite to landing. The downwind leg normally extends between the crosswind leg and the base leg.
4. Base Leg—A flightpath at right angles to the landing runway off its approach end. The base leg normally extends from the downwind leg to the intersection of the extended runway centerline.
5. Final Approach—A flight path in the direction of landing along the extended runway centerline. The final approach normally extends from the base leg to the runway. An aircraft making a straight-in approach VFR is also considered to be on final approach.

(See Straight-In Approach—VFR, Taxi Patterns.)

TRANSCRIBED WEATHER BROADCAST/ TWEB—A continuous recording to meteorological and aeronautical information that is broadcast on L/MF and VOR facilities for pilots.

TRANSFER OF CONTROL—That action whereby the responsibility for the separation of an aircraft is transferred from one controller to another.

TRANSFERRING CONTROLLER/FACILITY—A controller/facility transferring control of an aircraft to another controller/facility.

TRANSITION—

1. The general term that describes the change from one phase of flight or flight condition to another, e.g., transition from en route flight to the approach, or transition from instrument flight to visual flight.
2. A published procedure (SID Transition) used to connect the basic SID to one of several en route airways/jet routes, or a published procedure (STAR Transition) used to connect one of several en route airways/jet routes to the basic STAR.

TRANSITION AREA—(See Controlled Airspace.)

TRANSMISSOMETER—An apparatus used to determine visibility by measuring the transmission of light through the atmosphere. It is the measurement source for determining runway visual range (RVR) and runway visibility value (RVV). (See Visibility.)

transmitting in the blind/blind transmission—A transmission from one station to other stations, in circumstances where two-way communication cannot be established but where it is believed that the called stations may be able to receive the transmission.

TRANSPONDER—The airborne radar beacon receiver/transmitter portion of the Air Traffic Control Radar Beacon System (ATCRBS) which automatically receives radio signals from interrogators on the ground and selectively replies with a specific reply pulse or pulse group only to those interrogations being received on the mode to which it is set to respond. (See Interrogator.)

TURBOJET AIRCRAFT—An aircraft having a jet engine in which the energy of the jet operates a turbine which in turn operates the air compressor.

TURBOPROP AIRCRAFT—An aircraft having a jet engine in which the energy of the jet operates a turbine which drives the propeller.

T-VOR/TERMINAL-VERY HIGH FREQUENCY OMNIDIRECTIONAL RANGE STATION—A very high frequency terminal omnirange station located on or near an airport and used as an approach aid. (See Navigational Aid, VOR.)

TWO-WAY RADIO COMMUNICATIONS FAILURE—(See Lost Communications.)

ULTRAHIGH FREQUENCY (UHF)—The frequency band between 300 and 3,000 MHz. The band of radio frequencies used for military air/ground voice communications. In some instances, this may go as low as 225 MHz and still be referred to as UHF.

unable—Indicates inability to comply with a specific instruction, request, or clearance.

UNCONTROLLED AIRSPACE—Uncontrolled airspace is that portion of the airspace that has not been designated as continental control area, control area, control zone, terminal control area, or transition area, and within which ATC has neither the authority nor the responsibility for exercising control over air traffic. (See Controlled Airspace.)

UNDER THE HOOD—Indicates that the pilot is using a hood to restrict visibility outside the cockpit while simulating instrument flight. An appropriately rated pilot is required in the other control seat while this operation is being conducted. (Refer to FAR Part 91.)

UNICOM—A non-Government communication facility which may provide airport information at certain airports. Locations and frequencies of UNICOMs are shown on aeronautical charts and publications.

UNPUBLISHED ROUTE—A route for which no minimum altitude is published or charted for pilot use. It may include a direct route between NAVAIDs, a radial, a radar vector, or a final approach course beyond the segments of an instrument approach procedure. (See Published Route, Route.)

UPWIND LEG—(See Traffic Pattern.)

URGENCY—A condition of being concerned about safety, and of requiring timely but not immediate assistance; a potential distress condition.

VECTOR—A heading issued to an aircraft to provide navigational guidance by radar.

verify—Request confirmation of information, e.g., "verify assigned altitude."

verify specific direction of takeoff (or turns after takeoff)—Used by ATC to ascertain an aircraft's direction of takeoff and/or direction of turn after takeoff. It is normally used for IFR departures from an airport not having a control tower. When direct

communication with the pilot is not possible, the request and information may be relayed through an FSS, dispatcher, or by other means.

VERTICAL SEPARATION—Separation established by assignment of different altitudes or flight levels. (See Separation.)

VERTICAL TAKEOFF AND LANDING AIRCRAFT (VTOL) AIRCRAFT—Aircraft capable of vertical climbs and/or descents and of using very short runways or small areas for takeoffs and landings. These aircraft include, but are not limited to, helicopters. (See Short Takeoff and Landing Aircraft.)

VERY HIGH FREQUENCY/VHF—The frequency band between 30 and 300 MHz. Portions of this band, 108 to 118 MHz, are used for certain NAVAIDs; 118 to 136 MHz are used for civil air/ground voice communications. Other frequencies in this band are used for purposes not related to air traffic control.

VERY LOW FREQUENCY (VLF)—The frequency band between 3 and 30 kHz.

VFR AIRCRAFT/VFR FLIGHT—An aircraft conducting flight in accordance with visual flight rules. (See Visual Flight Rules.)

VFR CONDITIONS—Weather conditions equal to or better than the minimum for flight under visual flight rules. The term may be used as an ATC clearance/instruction only when:

1. An IFR aircraft requests a climb/descent in VFR conditions.

2. The clearance results in noise abatement benefits where part of the IFR departure route does not conform to an FAA-approved noise abatement route or altitude.

3. A pilot has requested a practice instrument approach and is not on an IFR flight plan.

All pilots receiving this authorization must comply with the VFR visibility and distance-from-cloud criteria in FAR Part 91. Use of the term does not relieve controllers of their responsibility to separate aircraft in TCAs/TRSAs as required by FAA Handbook 7110.65. When used as an ATC clearance/instruction, the term may be abbreviated "VFR," e.g., "Maintain VFR," "Climb/descend VFR," etc.

VFR conditions on-top/VFR-on-top—ATC authorization for an IFR aircraft to operate in VFR conditions at any appropriate VFR altitude (as specified in FAR and as restricted by ATC). A pilot receiving this authorization must comply with the VFR visibility, distance-from-cloud criteria, and the minimum IFR altitudes specified in FAR Part 91. The use of this term does not relieve controllers of their responsibility to separate aircraft in TCAs/TRSAs as required by FAA Handbook 7110.65.

VFR MILITARY TRAINING ROUTES (VR)—Routes used by the Department of Defense and associated Reserve and Air Guard units for the purpose of conducting low-altitude navigation and tactical training under VFR below 10,000 feet MSL at airspeeds in excess of 250 knots IAS.

VFR not recommended—An advisory provided by a flight service station to a pilot during a preflight or inflight weather briefing that flight under visual flight rules is not recommended. To be given when the current and/or forecasted weather conditions are at or below VFR minimums. It does not abrogate the pilot's authority to make his own decision.

VIDEO MAP—An electronically displayed map on the radar display that may depict data such as airports, heliports, runway centerline extensions, hospital emergency landing areas, NAVAIDs and fixes, reporting points, airway/route centerlines, boundaries, handoff points, special use tracks, obstructions, prominent geographic features, map alignment indicators, range accuracy marks, and minimum vectoring altitudes.

VISIBILITY—The ability, as determined by atmospheric conditions and expressed in units of distance, to see and identify prominent unlighted objects by day and prominent lighted objects by night. Visibility is reported as statute miles, hundreds of feet, or meters. (Refer to FAR Part 91.)

1. Flight Visibility—The average forward horizontal distance from the cockpit of an aircraft in flight, at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.

2. Ground Visibility—Prevailing horizontal visibility near the earth's surface as reported by the United States National Weather Service or an accredited observer.

3. Prevailing Visibility—The greatest horizontal visibility equaled or exceeded throughout at least half the horizon circle which need not necessarily be continuous.

4. Runway Visibility Value (RVV)—The visibility determined for a particular runway by a transmissometer. A meter provides a continuous indication of the visibility (reported in miles or fraction of miles) for the runway. RVV is used in lieu of prevailing visibility in determining minimums for a particular runway.

5. Runway Visual Range (RVR)—An instrumentally derived value, based on standard calibrations, that represents the horizontal distance a pilot sees down the runway from the approach end. It is based on the sighting of either high-intensity runway lights or on the visual contrast of other targets, whichever yields the greater visual range. RVR, in contrast to prevailing or runway visibility, is based on what a pilot in a moving aircraft should see when looking down the runway. RVR is horizontal visual range, not slant visual range. It is based on the measurement of a transmissometer made near the touchdown point of the instrument runway and is reported in hundreds of feet. RVR is used in lieu of RVV and/or prevailing visibility in determining minimums for a particular runway.

a. Touchdown RVR—The RVR visibility readout values obtained from RVR equipment serving the runway touchdown zone.

b. Mid-RVR—The RVR readout values obtained from RVR equipment located midfield of the runway.

c. Rollout RVR—The RVR readout values obtained from RVR equipment located nearest the rollout end of the runway.

VISUAL APPROACH—An approach wherein an aircraft on an IFR flight plan, operating in VFR conditions under the control of an air traffic control facility and having an air traffic control authorization, may proceed to the airport of destination in VFR conditions.

VISUAL APPROACH SLOPE INDICATOR—(See Airport Lighting.)

VISUAL DESCENT POINT (VDP)—A defined point on the final approach course of a nonprecision straight-in approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided the approach threshold of that runway, or approach lights, or other markings identifiable with the approach end of that runway are clearly visible to the pilot.

VISUAL FLIGHT RULES (VFR)—Rules that govern the procedures for conducting flight under visual conditions. The term "VFR" is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate type of flight plan. (See Instrument Flight Rules, Instrument Meteorological Conditions.) (Refer to FAR Part 91.)

VISUAL HOLDING—The holding of aircraft at selected, prominent, geographical fixes which can be easily recognized from the air. (See Hold, Holding Fixes.)

VISUAL METEOROLOGICAL CONDITIONS (VMC)—Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minima. (See Instrument Flight Rules, Instrument Meteorological Conditions, Visual Flight Rules.)

VISUAL SEPARATION—A means employed by ATC to separate aircraft in terminal areas. There are two ways to effect this separation:

1. The tower controller sees the aircraft involved and issues instructions, as necessary, to ensure that the aircraft avoid each other.

2. A pilot sees the other aircraft involved and upon instructions from the controller provides his own separation by maneuvering his aircraft, as necessary, to avoid it. This may involve following another aircraft or keeping it in sight until it is no longer a factor. (See See and Avoid.) (Refer to FAR Part 91.)

VORTAC/VHF OMNIDIRECTIONAL RANGE/TACTICAL AIR NAVIGATION—A navigation aid providing VOR azimuth, TACAN azimuth, and TACAN distance-measuring equipment (DME) at one site. (See Distance Measuring Equipment, Navigational Aid, TACAN, VOR.)

VORTICES/WING TIP VORTICES—Circular patterns of air created by the movement of an airfoil through the air when generating lift. As an airfoil moves through the atmosphere in sustained flight, an area of low pressure is created above it. The air flowing from the high-pressure area to the low-pressure area around and about the tips of the airfoil tends to roll up into two rapidly rotating vortices, conical in shape. These vortices are the most predominant parts of aircraft wake turbulence and their rotational force is dependent upon the wind loading, gross weight, and speed of the generating aircraft. The vortices from medium to heavy aircraft can be of extremely high velocity and hazardous to smaller aircraft. (See Aircraft Classes, Wake Turbulence.)

VOR/VERY HIGH FREQUENCY OMNIDIRECTIONAL RANGE STATION—A ground-based electronic navigation aid transmitting very high frequency navigation signals, 360° in azimuth, oriented from magnetic north. Used as the basis for navigation in the national airspace system. The VOR periodically identifies itself by Morse code and may have an additional voice identification feature. Voice features may be used by ATC or FSS for transmitting instructions/information to pilots. (See Navigational Aid.)

VOT/VOR TEST SIGNAL—A ground facility which emits a test signal to check VOR receiver accuracy. The system is limited to ground use only. (Refer to FAR Part 91.)

WAKE TURBULENCE—Phenomena resulting from the passage of an aircraft through the atmosphere. The term includes vortices, thrust stream turbulence, jet blast, jet wash, propeller wash, and rotor wash both on the ground and in the air. (See Aircraft Classes, Jet Blast, Vortices.)

WARNING AREA—(See Special Use Airspace.)

WAYPOINT—(See Area Navigation.)

WEATHER ADVISORY/INFLIGHT WEATHER ADVISORY—(See AIRMET, SIGMET.)

WEATHER ADVISORIES (WS/WA)—In aviation weather forecast practice, an expression of hazardous weather conditions not predicted in the area forecast as they affect the operation of air traffic and as prepared by the NWS.

wilco—I have received your message, understand it, and will comply with it.

WIND SHEAR—A change in wind speed and/or wind direction in a short distance, resulting in a tearing or shearing effect. It can exist in a horizontal or vertical direction and occasionally in both.

words twice—

1. As a request, "Communication is difficult. Please say every phrase twice."

2. As information, "Since communications are difficult, every phrase in this message will be spoken twice."

APPENDIX C

SELECTED AIR TRAFFIC CONTROL RELATED DIRECTIVES

NUMBER	SOURCE	TITLE
2112.2 (Series)	OPNAV	Naval Notices to Airmen (NOTAM)
3700.19 (Series)	OPNAV	Foreign Military Aircraft Landing Clearance Procedures
3710.2D	OPNAV	Foreign Clearance Procedures for U.S. Naval Aircraft
3710.7	OPNAV	NATOPS General Flight and Operating Instructions Manual, Promulgation of
3710.18	OPNAV	Unmanned Free Balloons, Moored Balloons and Kites, Unmanned Rockets and Derelict Friendly Airborne Objects
3710.31	OPNAV	Operational Procedures for Aircraft Carrying Dangerous Materials
3710.33	OPNAV	Sonic Boom Reporting, Inquiries, and Data Processing Instructions
3721.1	OPNAV	Air Traffic Control Facilities Manual
3721.1	NAVAIR	Flight Inspection of Naval Shore-Based Air Navigational Aids, Approach Systems and Communications Facilities
3721.5	OPNAV	Naval Air Traffic Control and Air Navigation Aid and Landing Systems (NAALS) Program
3721/18	OPNAV	U.S. Interagency Ground Inspection Manual, Air Traffic Control and Navigational Aids Facilities
3722.5	OPNAV	Identification and Security Control of Military Aircraft
3722.8	OPNAV	Federal Aviation Administration Flight Service Interphone Communications System Procedures
3722.16	OPNAV	U.S. Standard for Terminal Instrument Procedures (TERPS)
3722.30	OPNAV	Security Control of Air Traffic and Air Navigation Aids (SCATANA)
3730.3	OPNAV	Aircraft Hurricane Evacuation
3730.9	OPNAV	Aircraft Antihijacking Program
3750.6	OPNAV	Navy Aircraft Accident, Incident and Ground Accident Reporting Procedures

NUMBER	SOURCE	TITLE
3750.16	OPNAV	Participation in a Military Aircraft Safety Investigation
3760.1	OPNAV	Reporting and Investigating Alleged Violations of Flying Regulations
3770.1	SECNAV	Use of Department of the Navy Aviation Facilities by Other Than U.S. DOD Aircraft
3770.2	OPNAV	Airspace Procedures Manual
3770.2	SECNAV	Joint Military and Civil Use of Navy and Marine Corps Aviation Installations
5604.1	OCEANAV	Procedures for Requisitioning Material from the Defense Mapping Agency Hydrographic Center (DMAHC)
FAA Handbook	7110.10	Flight Services
FAA Handbook	7110.65	Air Traffic Control
FAA Handbook	7110.80	Data Communications
FAA Handbook	7130.3	Holding Pattern Criteria
6240.3E	OPNAV	Environmental Protection Manual
FAA Handbook	7210.3	Facility Management
FAA Handbook	7220.1	Certification and Rating Procedures
FAA Handbook	7400.2	Procedures for Handling Airspace Matters
FAA Handbook	7610.4	Special Military Operations
FAA Handbook	OAP 8200.1	U.S. Standard Flight Inspection Manual
FAR Part 1		Definitions and Abbreviations
FAR Part 65		Certification: Airman Other than Flight Crewman
FAR Part 67		Medical Standards and Certification
FAR Part 71		Designation of Federal Airways, Controlled Airspace and Reporting Points
FAR Part 73		Special Use Airspace
FAR Part 75		Establishment of Jet Routes
FAR Part 77		Objects Affecting Navigable Airspace
FAR Part 91		General Operating and Flight Rules
FAR Part 93		Special Air Traffic Rules and Airport Traffic Patterns
FAR Part 95		IFR Altitudes

NUMBER	SOURCE	TITLE
FAR Part 97		Standard Instrument Approach Procedures
FAR Part 99		Security Control of Air Traffic
FAR Part 101		Moored Balloons, Kites, Unmanned Rockets and Unmanned Free Balloons
FAR Part 105		Parachute Jumping
FAR Part 139		Certification and Operations of Airfields
	CNO	CV NATOPS Manual
	DMA	Defense Mapping Agency Catalog of Maps, Charts, and Related Products, Part 1, Aerospace Products
8600.3	DMA	Defense Mapping Agency (DMA) Distribution of Maps, Charts, and Related Publications

APPENDIX D

SELECTED FEDERAL AVIATION REGULATIONS

CONTENTS

PART 1—DEFINITIONS AND ABBREVIATIONS

1.1 GENERAL DEFINITIONS

As used in subchapters of this chapter, unless the context requires otherwise:

"Administrator" means the Federal Aviation Administrator or any person to whom he has delegated his authority in the matter concerned.

"Air carrier" means a person who undertakes directly by lease, or other arrangement, to engage in air transportation.

"Air commerce" means interstate, overseas, or foreign air commerce or the transportation of mail by aircraft or any operation or navigation of aircraft within the limits of any Federal airway or any operation or navigation of aircraft which directly affects, or which may endanger safety in, interstate, overseas, or foreign air commerce.

"Aircraft engine" means an engine that is used or intended to be used for propelling aircraft. It includes turbosuperchargers, appurtenances, and accessories necessary for its functioning, but does not include propellers.

"Airframe" means the fuselage, booms, nacelles, cowlings, fairings, airfoil surfaces (including rotors but excluding propellers and rotating airfoils of engines), and landing gear of an aircraft and their accessories and controls.

"Airplane" means an engine-driven fixed-wing aircraft heavier than air, that is supported in flight by the dynamic reaction of the air against its wings.

"Airport" means an area of land or water that is used or intended to be used for the landing and takeoff of aircraft, and includes its buildings and facilities, if any.

"Altitude engine" means a reciprocating aircraft engine having a rated takeoff power that is producible from sea level to an established higher altitude.

"Appliance" means any instrument, mechanism, equipment, part, apparatus, appurtenance, or accessory, including communications equipment, that is used or intended to be used in operating or controlling an aircraft in flight, is installed in or attached to the aircraft, and is not part of an airframe, engine, or propeller.

"Approved," unless used with reference to another person, means approved by the Administrator.

"Auxiliary rotor" means a rotor that serves either to counteract the effect of the main rotor torque on a rotorcraft or to maneuver the rotorcraft about one or more of its three principal axis.

"Balloon" means a lighter-than-air aircraft that is not engine-driven.

"Brake horsepower" means the power delivered at the propeller shaft (main drive or main output) of an aircraft engine.

"Calibrated airspeed" means indicated airspeed of an aircraft, corrected for position and instrument error. Calibrated airspeed is equal to true airspeed in standard atmosphere at sea level.

"Category"—

(1) As used with respect to the certification, ratings, privileges, and limitations of airmen, means a broad classification of aircraft. Examples include: airplane, rotorcraft; glider; and lighter-than-air; and

(2) As used with respect to the certification of aircraft, means a grouping of aircraft based upon intended use or operating limitations. Examples include: transport; normal; utility; acrobatic; limited; restricted; and provisional.

"Category II operation," with respect to the operation of aircraft, means a straight-in ILS approach to the runway of an airport under a Category II ILS instrument approach procedure issued by the Administrator or other appropriate authority.

"Civil aircraft" means aircraft other than public aircraft.

"Class"—

(1) As used with respect to the certification, ratings, privileges, and limitations of airmen, means a classification of aircraft within a category having similar operating characteristics. Examples include: single engine; multiengine; land; water; gyroplane; helicopter; airship; and free balloon; and

(2) As used with respect to the certification of aircraft, means a broad grouping of aircraft having similar characteristics of propulsion, flight, or landing. Examples include: airplane; rotorcraft; glider; balloon; landplane; and seaplane.

"Clearway: means"

(1) For turbine engine powered airplanes certificated after August 29, 1959, an area beyond the runway, not less than 500 feet wide, centrally located about the extended centerline of the runway, and under the control of the airport authorities. The clearway is expressed in terms of a clearway plane, extending from the end of the runway with an upward slope not exceeding 1.25 percent, above which no object nor any terrain protrudes. However, threshold lights may protrude above the plane if their height above the end of the runway is 26 inches or less and if they are located to each side of the runway.

(2) For turbine engine powered airplanes certificated after September 30, 1958, but before August 30, 1959, an area beyond the takeoff runway extending no less than 300 feet on either side of the extended centerline of the runway, at an elevation no higher than the elevation of the end of the runway, clear of all fixed obstacles, and under the control of the airport authorities.

"Crewmember" means a person assigned to perform duty in an aircraft during flight time.

"Critical altitude" means the maximum altitude at which, in standard atmosphere, it is possible to maintain, at a specified rotational speed, a specified power or a specified manifold pressure. Unless otherwise stated, the critical altitude is the maximum altitude at which it is possible to maintain, at the maximum continuous rotational speed, one of the following:

(1) The maximum continuous power, in the case of engines for which this power rating is the same at sea level and at the rated altitude.

(2) The maximum continuous rated manifold pressure, in the case of engines, the maximum continuous power of which, is governed by a constant manifold pressure.

"Critical engine" means the engine whose failure would most adversely affect the performance or handling qualities of an aircraft.

"Equivalent airspeed" means the calibrated airspeed of an aircraft corrected for adiabatic compressible flow for the particular altitude. Equivalent airspeed is equal to calibrated airspeed in standard atmosphere at sea level.

"Extended over-water operation" means—

(1) With respect to aircraft other than helicopters, and operation over water at a horizontal distance of more than 50 nautical miles from the nearest shoreline; and

(2) With respect to helicopters, an operation over water at a horizontal distance of more than 50 nautical miles from the nearest shoreline and more than 50 nautical miles from an off-shore heliport structure.

"External load" means a load that is carried, or extends, outside of the aircraft fuselage.

"External load attaching" means the structural components used to attach an external load to an aircraft, including external-load containers, the backup structure at the attachment points, and any quick-release device used to jettison the external load.

"Fireproof"—

(1) With respect to materials and parts used to confine fire in a designated fire zone, means the capacity to withstand at least as well as steel in dimensions appropriate for the purpose for which they are used, the heat produced when there is a severe fire of extended duration in that zone; and

(2) With respect to other materials and parts, means the capacity to withstand the heat associated with fire at least as well as steel in dimensions appropriate for the purpose for which they are used.

"Fire resistant"—

(1) With respect to sheet or structural members means the capacity to withstand the heat associated with fire at least as well as aluminum alloy in dimensions appropriate for the purpose for which they are used; and

(2) With respect to fluid-carrying lines, fluid system parts, wiring, air ducts, fittings, and powerplant controls, means the capacity to perform the intended functions under the heat and other conditions likely to occur when there is a fire at the place concerned.

"Flame resistant" means not susceptible to combustion to the point of propagating a flame, beyond safe limits, after the ignition source is removed.

"Flammable", with respect to a fluid or gas, means susceptible to igniting readily or to exploding.

"Flap extended speed" means the highest speed permissible with wing flaps in a prescribed extended position.

"Flash resistant" means not susceptible to burning violently when ignited.

"Flight crewmember" means a pilot, flight engineer, or flight navigator assigned to duty in an aircraft during flight time.

"Flight time" means the time from the moment the aircraft first moves under its own power for the purpose of flight until the moment it comes to rest at the next point of landing. ("Block-to-block" time.)

"Glider" means a heavier-than-air aircraft, that is supported in flight by the dynamic reaction of the air against its lifting surfaces and whose free flight does not depend principally on an engine.

"Helicopter" means a rotorcraft that, for its horizontal motion, depends principally on its engine-driven rotors.

"Indicated airspeed" means the speed of an aircraft as shown on its pitot static airspeed indicator calibrated to reflect standard atmosphere adiabatic compressible flow at sea level uncorrected for airspeed system errors.

"Instrument" means a device using an internal mechanism to show visually or aurally the attitude, altitude, or operation of an aircraft or aircraft part. It includes electronic devices for automatically controlling an aircraft in flight.

"Large aircraft" means aircraft of more than 12,500 pounds, maximum certificated takeoff weight.

"Lighter-than-air aircraft" means aircraft that can rise and remain suspended by using contained gas weighing less than the air that is displaced by the gas.

"Main rotor" means the rotor that supplies the principal lift to a rotorcraft.

"Maintenance" means inspection, overhaul, repair, preservation, and the replacement of parts, but excludes preventive maintenance.

"Medical certificate" means acceptable evidence of physical fitness on a form prescribed by the Administrator.

"Operate," with respect to aircraft, means use, cause to use or authorize to use aircraft, for the purpose (except as provided in 91.10 of this chapter) of air navigation including the piloting of aircraft, with or without the right of legal control (as owner, lessee, or otherwise).

"Operational control," with respect to a flight, means the exercise of authority over initiating, conducting, or terminating a flight.

"Over-the-top" means above the layer of clouds or other obscuring phenomena forming the ceiling.

"Parachute" means a device used or intended to be used to retard the fall of a body or object through the air.

"Person" means an individual, firm, partnership, corporation, company, association, joint-stock association, or governmental entity. It includes a trustee, receiver, assignee, or similar representative of any of them.

"Pilotage" means navigation by visual reference to landmarks.

"Pilot in command" means the pilot responsible for the operation and safety of an aircraft during flight time.

"Preventive maintenance" means simple or minor preservation operations and the replacement of small standard parts not involving complex assembly operations.

"Propeller" means a device for propelling an aircraft that has blades on an engine-driven shaft and that, when rotated, produces by its action on the air, a thrust approximately perpendicular to its plane of rotation. It includes control components normally supplied by its manufacturer, but does not include main and auxiliary rotors or rotating airfoils of engines.

"Rating" means a statement that, as a part of a certificate, sets forth special conditions, privileges, or limitations.

"Rocket" means an aircraft propelled by ejected expanding gases generated in the engine from self-contained propellants and not dependent on the intake of outside substances. It includes any part which becomes separated during the operation.

"Rotorcraft" means a heavier-than-air aircraft that depends principally for its support in flight on the lift generated by one or more rotors.

"Second in command" means a pilot who is designated to be second in command of an aircraft during flight time.

"Show," unless the context otherwise requires, means to show to the satisfaction of the Administrator.

"Small aircraft" means aircraft of 12,500 pounds or less, maximum certificated takeoff weight.

"Stopway" means an area beyond the takeoff runway, no less wide than the runway and centered upon the extended centerline of the runway, able to support the airplane during an aborted takeoff, without causing structural damage to the airplane, and designated by the airport authorities for use in decelerating the airplane during an aborted takeoff.

"True airspeed" means the airspeed of an aircraft relative to undisturbed air. True airspeed is equal to equivalent airspeed multiplied by (po/p) 1/2.

"Type"—

(1) As used with respect to the certification, ratings, privileges, and limitations of airmen, means a specific make and basic model of aircraft, including modifications thereto that do not change its handling or flight characteristics. Examples include: DC-7, 1049, and F-27; and

(2) As used with respect to the certification of aircraft, means those aircraft which are similar in design. Examples include: DC-7 and DC-7C; 1049G and 1049H; and F-27 and F-27F.

(3) As used with respect to the certification of aircraft engines means those engines which are similar in design. For example, JT8D and JT8D-7 are engines of the same type, and JT9D-3A and JT9D-7 are engines of the same type.

"United States," in a geographical sense, means (1) the States, the District of Columbia, Puerto Rico, and the possessions, including the territorial waters, and (2) the airspace of those areas.

1.2 ABBREVIATIONS AND SYMBOLS

In Subchapters A through K of this chapter:

"AGL" means above ground level.

"ALS" means approach light system.

"ASR" means airport surveillance radar.

"ATC" means air traffic control.

"CAS" means calibrated airspeed.

"CAT II" means Category II.

"CONSOL or CONSOLAN" means a kind of low or medium frequency long range navigational aid.

"DH" means decision height.

"DME" means distance measuring equipment compatible with TACAN.

"EAS" means equivalent airspeed.

"FAA" means Federal Aviation Administration.

"FM" means fan marker.

"GS" means glide slope.

"HIRL" means high-intensity runway light system.

"IAS" means indicated airspeed.

"ICAO" means International Civil Aviation Organization.

"IFR" means instrument flight rules.

"ILS" means instrument landing system.

"IM" means ILS inner marker.

"INT" means intersection.

"LDA" means localizer-type directional aid.

"LFR" means low frequency radio range.

"LMM" means compass locator at middle marker.

"LOC" means ILS localizer.

"LOM" means compass locator at outer marker.

"M" means mach number.

"MAA" means maximum authorized IFR altitude.

"MALS" means medium intensity approach light system.

"MALSR" means medium intensity approach light system with runway alignment indicator lights.

"MCA" means minimum crossing altitude.

"MDA" means minimum descent altitude.

"MEA" means minimum en route IFR altitude.

"MM" means ILS middle marker.

"MOCA" means minimum obstruction clearance altitude.

"MRA" means minimum reception altitude.

"MSL" means mean sea level.

"NDB(ADF)" means nondirectional beacon (automatic direction finder).

"NOPT" means no procedure turn required.

"OM" means ILS outer marker.

"PAR" means precision approach radar.

"RAIL" means runway alignment indicator light system.

"RBN" means radio beacon.

"RCLM" means runway centerline marking.

"RCLS" means runway centerline light system.

"REIL" means runway end identification lights.

"RR" means low or medium frequency radio range station.

"RVR" means runway visual range as measured in the touchdown zone area.

"SALS" means short approach light system.

"SSALS" means simplified short approach light system.

"SSALSR" means simplified short approach light system with runway alignment indicator lights.

"TACAN" means ultra-high frequency tactical air navigational aid.

"TAS" means true airspeed.

"TDZL" means touchdown zone lights.

"TVOR" means very high frequency terminal omnirange station.

"VFR" means visual flight rules.

"VHF" means very high frequency.

"VOR" means very high frequency omnirange station.

"VORTAC" means collocated VOR and TACAN.

RULES OF CONSTRUCTION

(a) In Subchapters of this chapter, unless the context requires otherwise:

(1) Words importing the singular include the plural;

(2) Words importing the plural include the singular; and

(3) Words importing the masculine gender include the feminine.

(b) In Subchapters of this chapter, the word:

(1) "Shall" is used in an imperative sense;

(2) "May" is used in a permissive sense to state authority or permission to do the act prescribed, and the words "no person may . . ." or "a person may not . . ." mean that no person is required, authorized, or permitted to do the act prescribed; and

(3) "Includes" means "includes but is not limited to."

PART 65—CERTIFICATION: AIRMEN OTHER THAN FLIGHT CREWMEMBERS

SUBPART A—GENERAL

65.1—Applicability.

This part prescribes the requirements for issuing the following certificates and associated ratings and the general operating rules for the holders of those certificates and ratings:

(a) Air traffic control tower operators
(b) Aircraft dispatchers
(c) Mechanics
(d) Repairmen
(e) Parachute riggers.

65.11—Application and issue.

(a) An application for a certificate and rating, or for an additional rating, under this part is made on a form and in a manner prescribed by the Administrator.

(b) An applicant who meets the requirements of this part is entitled to an appropriate certificate and rating.

(c) Unless authorized by the Administrator, a person whose air traffic control tower operator, mechanic, or parachute rigger certificate is suspended may not apply for any rating to be added to that certificate during the period of suspension.

(d) Unless the order of revocation provides otherwise—

(1) A person whose air traffic control tower operator, aircraft dispatcher, or parachute rigger certificate is revoked may not apply for the same kind of certificate for one year after the date of revocation; and

(2) A person whose mechanic or repairman certificate is revoked may not apply for either of those kinds of certificates for one year after the date of revocation.

65.12—Offenses involving narcotic drugs, marijuana, and depressant or stimulant drugs or substances.

(a) No person who is convicted of violating any Federal or State statute relating to the growing, processing, manufacture, sale, disposition, possession, transportation or importation of narcotic drugs, marijuana, and depressant or stimulant drugs or substances, is eligible for any certificate or rating issued under this part for a period of 1 year after the date of final conviction.

(b) Deleted.

(c) Any conviction specified in paragraph (a) of this section, is grounds for suspending or revoking any certificate or rating issued under this part.

65.13—Temporary certificate.

A certificate and ratings effective for a period of not more than 120 days may be issued to a qualified applicant, pending review of his application and supplementary documents and the issue of the certificate and ratings for which he applied.

65.15—Duration of certificates.

(a) Except for repairman certificates, a certificate or rating issued under this part is effective until it is surrendered, suspended, or revoked.

(b) Deleted.

(c) The holder of any certificate issued under this part that is suspended or revoked shall, upon the Administrator's request, return it to the Administrator.

65.16—Change of name; replacement of lost or destroyed certificate.

(a) An application for a change of name on a certificate issued under this part must be accompanied by the applicant's current certificate and the marriage license, court order, or other document verifying the change. The documents are returned to the applicant after inspection.

(b) An application for a replacement of a lost or destroyed certificate is made by letter to the Department of Transportation. Federal Aviation Administration, Airman Certification Branch, P.O. Box 25082, Oklahoma City, Oklahoma 73125. The letter must—

(1) Contain the name in which the certificate was issued, the permanent mailing address (including zip code), social security number (if any), and date and place of birth of the certificate holder, and any available information regarding the grade, number, and date of issue of the certificate, and the ratings on it; and

(2) Be accompanied by a check or money order for $2.00, payable to the Federal Aviation Administration.

(c) An application for a replacement of a lost or destroyed medical certificate is made by letter to the Department of Transportation, Federal Aviation Administration, Civil Aeromedical Institute, Aeromedical Certification Branch, P.O. Box 25082, Oklahoma City, Oklahoma 73125, accompanied by a check or money order for $2.00.

(d) A person whose certificate issued under this part or medical certificate, or both, has been lost may obtain a telegram from the FAA confirming that it was issued. The telegram may be carried as a certificate for a period not to exceed 60 days pending his receiving a duplicate certificate under paragraph (b) or (c) of this section, unless he has been notified that the certificate has been suspended or revoked. The request for such a telegram may be made by prepaid telegram, stating the date upon which a duplicate certificate was requested, or including the request for a duplicate and a money order for the necessary amount. The request for a telegraphic certificate should be sent to the office prescribed in paragraph (b) or (c) of this section, as appropriate. However, a request for both at the same time should be sent to the office prescribed in paragraph (b) of this section.

65.17—Tests: General procedure.

(a) Tests prescribed by or under this part are given at times and places, and by persons, designated by the Administrator.

(b) The minimum passing grade for each test is 70 percent.

65.18—Written tests: Cheating or other unauthorized conduct.

(a) Except as authorized by the Administrator, no person may—

(1) Copy, or intentionally remove, a written test under this part;

(2) Give to another, or receive from another, any part or copy of that test;

(3) Give help on that test to, or receive help on that test from, any person during the period that test is being given;

(4) Take any part of that test in behalf of another person;

(5) Use any material or aid during the period that test is being given; or

(6) Intentionally cause, assist, or participate in any act prohibited by this paragraph.

(b) No person who commits an act prohibited by paragraph (a) of this section is eligible for any airman or ground instructor certificate or rating under this chapter for a period of 1 year after the date of that act. In addition, the commission of that act is a basis for suspending or revoking any airman or ground instructor certificate or rating held by that person.

65.19—Retesting after failure.

An application for a written, oral, or practical test for a certificate and rating, or for an additional rating under this part, may apply for retesting—

(a) After 30 days after the date the applicant failed the test; or

(b) Before the 30 days have expired if the applicant presents a signed statement from an airman holding the certificate and rating sought by the applicant, certifying that the airman has given the applicant additional instruction in each of the subjects failed and that the airman considers the applicant ready for retesting.

65.20—Applications, certificates, logbooks, reports, and records: falsification, reproduction, or alteration.

(a) No person may make or cause to be made—

(1) Any fraudulent or intentionally false statement on any application for a certificate or rating under this part;

(2) Any fraudulent or intentionally false entry in any logbook, record, or report that is required to be kept, made, or used, to show compliance with any requirement for any certificate or rating under this part;

(3) Any reproduction, for fraudulent purpose, of any certificate or rating under this part; or

(4) Any alteration of any certificate or rating under this part.

(b) The commission by any person of an act prohibited under paragraph (a) of this section is a basis for suspending or revoking any airman or ground instructor certificate or rating held by that person.

65.21—Change of address.

Within 30 days after any change in his permanent mailing address, the holder of a certificate issued under this part shall notify the Department of Transportation, Federal Aviation Administration, Airman Certification Branch, P.O. Box 25082, Oklahoma City, Oklahoma 73125 in writing, of his new address.

SUBPART B—AIR TRAFFIC CONTROL TOWER OPERATORS

65.31—Required certificate, and rating or qualification.

No person may act as an air traffic control tower operator at an air traffic control tower in connection with civil aircraft unless he—

(a) Holds an air traffic control tower operator certificate issued to him under this subpart; and

(b) Holds a facility rating for that control tower issued to him under this subpart, or has qualified for the operating position at which he acts and is under the supervision of the holder of a facility rating for that control tower. For the purpose of this subpart, "operating position" means an air traffic control function performed within or directly associated with the control tower.

65.33—Eligibility requirements: general.

To be eligible for an air traffic control tower operator certificate, a person must—

(a) Be at least 18 years of age;

(b) Be of good moral character;

(c) Be able to read, write, and understand the English language and speak it without accent or impediment of speech that would interfere with 2-way radio conversation;

(d) Hold at least a second-class medical certificate issued under part 67 of this chapter within the 12 months before the date he applies; and

(e) Comply with 65.35.

65.35—Knowledge requirements.

Each applicant for an air traffic control tower operator certificate must pass a written test on—

(a) The flight rules in part 91 of this chapter;

(b) Airport traffic control procedures, and this subpart;

(c) En route traffic control procedures;

(d) Communications operating procedures;

(e) Flight assistance service;

(f) Air navigation, and aids to air navigation; and

(g) Aviation weather.

65.37—Skill requirements; operating positions.

No person may act as an air traffic control tower operator at any operating position unless he has passed a practical test on—

(a) Control tower equipment and its use;

(b) Weather reporting procedures and use of reports;

(c) Notices to Airmen, and use of the Airman's Information Manual;

(d) Use of operational forms;

(e) Performance of noncontrol operational duties; and

(f) Each of the following procedures that is applicable to that operating position and is required by the person examining him:

(1) The airport, including rules, equipment, runways, taxiways, and obstructions.

(2) The control zone, including terrain features, visual checkpoints, and obstructions.

(3) Traffic patterns and associated procedures for use of preferential runways and noise abatement.

(4) Operational agreements.

(5) The center, alternate airports, and those airways, routes, reporting points, and air navigation aids used for terminal air traffic control.

(6) Search and rescue procedures.

(7) Terminal air traffics control procedures and phraseology.

(8) Holding procedures, prescribed instrument approach, and departure procedures.

(9) Radar alignment and technical operation.

(10) The application of the prescribed radar and nonradar separation standard, as appropriate.

65.39—Practical experience requirements; facility rating.

Each applicant for a facility rating at any air traffic control tower must have satisfactorily served—

(a) As an air traffic control tower operator at that control tower without a facility rating for at least 6 months; or

(b) As an air traffic control tower operator with a facility rating at a different control tower for at least 6 months before the date he applies for the rating.

However, an applicant who is a member of an Armed Force of the United Sates meets the requirements of this section if he has satisfactorily served as an air traffic control tower operator for at least 6 months.

65.41—Skill requirements: facility ratings.

Each applicant for a facility rating at an air traffic control tower must have passed a practical test on each item listed in 65.37 of this part that is applicable to each operating position at the control tower at which the rating is sought.

65.45—Performance of duties.

(a) An air traffic control tower operator shall perform his duties in accordance with the limitations on his certificate and the procedures and practices prescribed in air traffic control manuals of the FAA, to provide for the safe, orderly, and expeditious flow of air traffic.

(b) An operator with a facility rating may control traffic at any operating position at the control tower at which he holds a facility rating. However, he may not issue an air traffic clearance for IFR flight without authorization from the appropriate facility exercising IFR control at that location.

(c) An operator who does not hold a facility rating for a particular control tower may act at each operating position for which he has qualified, under the supervision of an operator holding a facility rating for that control tower.

65.47—Maximum hours.

Except in an emergency, a certificated air traffic control tower operator must be relieved of all duties for at least 24 consecutive hours at least once during each 7 consecutive days. Such an operator may not serve or be required to serve—

(a) For more than 10 consecutive hours; or

(b) For more than 10 hours during a period of 24 consecutive hours, unless he has had a rest period of at least 8 hours at or before the end of the 10 hours of duty.

65.49—General operating rules.

(a) No person may act as an air traffic control tower operator under a certificate issued to him under this part unless he has in his personal possession an appropriate current medical certificate issued under part 67 of this chapter.

(b) Each person holding an air traffic control tower operator certificate shall keep it readily available when performing duties in an air traffic control tower, and shall present that certificate or his medical certificate or both for inspection upon the request of the Administrator or an authorized representative of the National Transportation Safety Board, or of any Federal, State, or local law enforcement officer.

(c) A certificated air traffic control tower operator who does not hold a facility rating for a particular control tower may not act at any operating position at the control tower concerned unless there is maintained at that control tower, readily available to persons named in paragraph (b), a current record of the operating positions at which he has qualified.

(d) An air traffic control tower operator may not perform duties under his certificate during any period of known physical deficiency that would make him unable to meet the physical requirements for his current medical certificate. However, if the deficiency is temporary, he may perform duties that are not affected by it whenever another certificated and qualified operator is present and on duty.

(e) A certificated air traffic control tower operator may not control air traffic with equipment that the Administrator has found to be inadequate.

(f) The holder of an air traffic control tower operator certificate, or an application for one, shall, upon the reasonable request of the Administrator, cooperate fully in any test that is made of him.

65.50—Currency requirements.

The holder of an air traffic control tower operator certificate may not perform any duties under that certificate unless—

(a) He has served for at least 3 of the preceding 6 months as an air traffic control tower operator at the control tower to which his facility rating applies, or at the operating positions for which he has qualified; or

(b) He has shown that he meets the requirements for his certificate and facility rating at the control tower concerned, or for operating at positions for which he has previously qualified.

PART 67—MEDICAL STANDARDS AND CERTIFICATION

SUBPART A—GENERAL

67.1—Applicability.

This subpart prescribes the medical standards for issuing medical certificates for airmen.

67.11—Issue.

An applicant who meets the medical standards prescribed in this part, based on medical examination and evaluation of his history and condition is entitled to an appropriate medical certificate.

67.15—Second class medical certificate.

(a) To be eligible for a second-class medical certificate, an applicant must meet the requirements of paragraphs (b) through (f) of this section.

(b) Eye:

(1) Distant visual acuity of 20/20 or better in *each eye separately, without correction;* or of at least 20/100 in each eye separately corrected to 20/20 or better with corrective lenses (glasses or contact lenses), in which case the applicant may be qualified only on the condition that he wears those corrective lenses while exercising the privileges of his airman certificate.

(2) Enough accommodation to pass a test prescribed by the Administrator based primarily on ability to read official aeronautical maps.

(3) Normal fields of vision.

(4) No pathology of the eye.

(5) Ability to distinguish aviation signal red, aviation signal green, and white.

(6) Bifoveal fixation and vergencephoria relationship sufficient to prevent a break in fusion under conditions that may reasonably occur in performing airman duties.

Tests for the factors named in subparagraph (6) of this paragraph are not required except for applicants found to have more than one prism diopter of hyperphoria, six prism diopters of esophoria, or six prism diopters of exophoria. If these values are exceeded, the Federal Air Surgeon may require the applicant to be examined by a qualified eye specialist to determine if there is bifoveal fixation and adequate vergencephoria relationship. However, if the applicant is otherwise qualified, he is entitled to a medical certificate pending the results of the examination.

(c) Ear, nose, throat, and equilibrium:

(1) Ability to hear the whispered voice at 8 feet with each ear separately.

(2) No acute or chronic disease of the middle or internal ear.

(3) No disease of the mastoid.

(4) No unhealed (unclosed) perforation of the eardrum.

(5) No disease or malformation of the nose or throat that might interfere with, or be aggravated by, flying.

(6) No disturbance in equilibrium.

(d) Mental and neurologic:

(1) Mental.

(i) No established medical history or clinical diagnosis of any of the following:

(a) A personality disorder that is severe enough to have repeatedly manifested itself by overt acts.

(b) A psychosis.

(c) Alcoholism. As used in this section, "alcoholism" means a condition in which a person's intake of alcohol is great enough to damage his physical health or personal or social functioning, or when alcohol has become a prerequisite to his normal functioning.

(d) Drug dependence. As used in this section, "drug dependence" means a condition in which a person is addicted to or dependent on drugs other than alcohol, tobacco, or ordinary caffeine-containing beverages, as evidenced by habitual use or a clear sense of need for the drug.

(ii) No other personality disorder, neurosis, or mental condition that the Federal Air Surgeon finds—

(a) Makes the applicant unable to safely perform the duties or exercise the privileges of the airman certificate that he holds or for which he is applying; or

(b) May reasonably be expected, within two years after the finding, to make him unable to perform those duties or exercise those privileges; and the findings are based on the case history and appropriate, qualified, medical judgment relating to the condition involved.

(2) Neurologic.

(i) No established medical history or clinical diagnosis of either of the following:

(a) Epilepsy.

(b) A disturbance of consciousness without satisfactory medical explanation of the cause.

(ii) No other convulsive disorder, disturbance of consciousness, or neurologic condition that the Federal Air Surgeon finds—

(a) Makes the applicant unable to safely perform the duties or exercise the privileges of the airman certificate that he holds or for which he is applying; or

(b) May reasonably be expected, within two years after the finding, to make him unable to perform those duties or exercise those privileges; and the findings are based on the case history and appropriate, qualified, medical judgment relating to the condition involved.

(e) Cardiovascular:

(1) No established medical history or clinical diagnosis of—

(i) Myocardial infarction; or

(ii) Angina pectoris or other evidence of coronary heart disease that the Federal Air Surgeon finds may reasonably be expected to lead to myocardial infarction.

(f) General medical condition:

(1) No established medical history or clinical diagnosis of diabetes mellitus that requires insulin or any other hypoglycemic drug for control.

(2) No other organic, functional, or structural disease, defect, or limitation that the Federal Air Surgeon finds—

(i) Makes the applicant unable to safely perform the duties or exercise the privileges of the airman certificate that he holds or for which he is applying; or

(ii) May reasonably be expected, within 2 years after the finding to make him unable to perform those duties or exercise those privileges; and the findings are based on the case history and appropriate, qualified, medical judgment relating to the condition involved.

PART 71—DESIGNATION OF FEDERAL AIRWAYS, AREA LOW ROUTES, CONTROLLED AIRSPACE, AND REPORTING POINTS

SUBPART A—GENERAL

71.3 Classification of Federal airways.

Federal airways are classified as follows:

(a) Colored Federal airways:

(1) Green Federal airways.

(2) Amber Federal airways.

(3) Red Federal airways.

(4) Blue Federal airways.

(b) VOR Federal airways.

71.5 Extent of Federal airways.

(a) Each Federal airway is based on a centerline that extends from one navigational aid or intersection to another navigational aid (or through several navigational aids or intersections) specified for that airway.

(b) Unless otherwise specified in Subpart B or C—each Federal airway includes the airspace within paralleled boundary lines 4 miles each side of the centerline. Where an airway changes direction, it includes that airspace enclosed by extending the boundary lines of the airway segments until they meet;

(c) Unless otherwise specified in Subpart B or C—

(1) Each Federal airway includes that airspace extending upward from 1,200 feet above the surface of the Earth to, but not including 18,000 feet MSL, except that Federal airways for Hawaii have no upper limits. Variations of the lower limits of an airway are expressed in digits representing hundreds of feet above the surface (AGL) or mean sea level (MSL) and, unless otherwise specified, apply to the segment of an airway between adjoining navigational aids or intersections; and

(2) The airspace of a Federal airway within the lateral limits of a transition area has a floor coincident with the floor of the transition area.

(d) One or more alternate airways may be designated between specified navigational aids or intersections along each VOR Federal airway described in Subpart C. Unless otherwise specified, the centerline of an alternate VOR Federal airway and the centerline of the corresponding segment of the main VOR Federal airway are separated by 15°.

(e) A Federal airway does not include the airspace of a prohibited area.

71.7 Control areas.

Control areas consist of the airspace designated in Subparts B, C, E, and J, but do not include the continental control area. Unless otherwise designated, control areas include the airspace between a segment of a main VOR Federal airway and its associated alternate segments with the vertical extent of the area corresponding to the vertical extent of the related segment of the main airway.

71.9 Continental control area.

The continental control area consists of the airspace of the 48 contiguous States, the District of Columbia and Alaska, excluding the Alaska peninsula west of Long.160°00′00″W., at and above 14,500 feet MSL, but does not include—

(a) The airspace less than 1,500 feet above the surface of the Earth; or

(b) Prohibited and restricted areas, other than restricted areas listed in Subpart D of this Part.

71.11 Control zones.

The control zones listed in Subpart F of this Part consist of controlled airspace which extends upward from the surface of the Earth and terminates at the base of the continental control area. Control zones that do not underlie the continental control area have no upper limit. A control zone may include one or more airports and is normally a circular area with a radius of 5 miles and any extensions necessary to include instrument approach and departure paths.

71.12 Terminal control areas.

The terminal control areas listed in Subpart K of this Part consist of controlled airspace extending upward from the surface or higher to specified altitudes, within which all aircraft are subject to operating rules, pilot rules, or equipment rules specified in Part 91 of this chapter. Each such location is designated as a Group I, Group II, or Group III Terminal Control Area, and includes at least one primary airport around which the terminal control area is located.

71.13 Transition areas.

The transition areas listed in Subpart G of this Part consist of controlled airspace extending upward from 700 feet or more above the surface of the Earth when designated in conjunction with an airport for which an approved instrument approach procedure has been prescribed; or from 1,200 feet or more above the surface of the Earth when designated in conjunction with airway route structures or segments. Unless otherwise specified, transition areas terminate at the base of the overlying controlled airspace.

71.15 Positive control areas.

The positive control areas listed in Subpart H of this Part consist of controlled airspace within which there is positive control of aircraft.

71.17 Reporting points.

(a) The reporting points listed in Subpart I of this Part consist of geographic locations, in relation to which the position of an aircraft must be reported in accordance with 91.125 of this chapter.

(b) Unless otherwise designated, each reporting point applies to all directions of flight. In any case where a geographical location is designated as a reporting point for less than all airways passing through that point, or for a particular direction of flight along an airway only, it is so indicated by including the airways or direction of flight in the designation of geographical location.

(c) Unless otherwise specified, place names appearing in the reporting point descriptions indicate VOR or VORTAC facilities identified by those names.

71.19 Bearings; radials; miles.

(a) All bearings and radials in this Part are true, and are applied from point of origin.

(b) Except as otherwise specified and except that mileages for Federal airways are stated as nautical miles, all mileages in this Part are stated as statute miles.

SUBPART B—COLORED FEDERAL AIRWAYS

71.101 Designation.

The airspace assignments described in this subpart are designated as colored Federal airways.

71.103 Green Federal airways.

71.105 Amber Federal airways.

71.107 Red Federal airways.

71.109 Blue Federal airways.

SUBPART C—VOR FEDERAL AIRWAYS

71.121 Designation.

The airspace assignments described in this subpart are designated as VOR Federal airways. Unless otherwise specified, place names appearing in the descriptions indicate VOR or VORTAC navigational facilities identified by those names.

71.123 Domestic VOR Federal airways.

71.125 Alaskan VOR Federal airways.

71.127 Hawaiian VOR Federal airways.

SUBPART D—CONTINENTAL CONTROL AREA

71.151 Restricted areas included.

The airspace of the following restricted areas at or above 14,500 feel MSL and 1,500 feet or more above the surface of the Earth is continental control area.

SUBPART E—CONTROL AREAS AND CONTROL AREA EXTENSIONS

71.161 Designation of control areas associated with jet routes outside the continental control area.

Unless otherwise specified, the airspace centered on each of the following jet route segments has a vertical extent identical to that of a jet route and a lateral extent identical to that of a Federal airway and is designated as a control area. Unless otherwise specified, the place names appearing in the descriptions indicate VOR or VORTAC facilities identified by those names. The airspace descriptions in this Part are published in the Federal Register. Due to their complexity and length they are not included here.

PART 73—SPECIAL USE AIRSPACE

SUBPART A—GENERAL

73.1 Applicability.

The airspace that is described in Subpart B and Subpart C of this Part is designated as special use airspace. This Part prescribes the requirements for the use of that airspace.

73.3 Special use airspace.

(a) Special use airspace consists of airspace of defined dimensions identified by an area on the surface of the earth wherein activities must be confined because of their nature, or wherein limitations are imposed upon aircraft operations that are not a part of those activities, or both.

(b) The vertical limits of special use airspace are measured by designated altitude floors and ceilings expressed as flight levels or as feet above mean sea level. Unless otherwise specified, the word "to" (an altitude or flight level) means "to and including" (that altitude or flight level).

(c) The horizontal limits of special use airspace are measured by boundaries described by geographic coordinates or other appropriate references that clearly define their perimeter.

(d) The period of time during which a designation of special use airspace is in effect is stated in the designation.

73.5 Bearings, radials; miles

(a) All bearings and radials in this Part are true from point of origin.

(b) Unless otherwise specified, all mileages in this Part as stated as statute miles.

SUBPART B—RESTRICTED AREAS

73.11 Applicability.

This subpart designates restricted areas and prescribes limitations on the operation of aircraft within them.

73.13 Restrictions.

No person may operate an aircraft within a restricted area between the designated altitudes and during the time of designation, unless he has the advance permission of—

(a) The using agency described in 73.15; or

(b) The controlling agency described in 73.17.

73.15 Using agency.

(a) For the purposes of this subpart, the following are using agencies:

(1) The agency, organization, or military command whose activity within a restricted area necessitated the area being so designated.

(2) Reserved.

(b) Upon the request of the FAA, the using agency shall execute a letter establishing procedures for joint use of a restricted area by the using agency and the controlling agency, under which the using agency would notify the controlling agency whenever the controlling agency may grant permission for transit through the restricted area in accordance with the terms of the letter.

(c) The using agency shall—

(1) Schedule activities within the restricted area;

(2) Authorize transit through, or flight within, the restricted area as feasible; and

(3) Contain within the restricted area all activities conducted therein in accordance with the purpose for which it was designated.

73.17 Controlling agency.

For the purposes of this Part, the controlling agency is the FAA facility that may authorize transit through or flight within a restricted area in accordance with a joint-use letter issued under 73.15.

73.19 Reports by using agency.

(a) Each using agency shall prepare a report on the use of each restricted area assigned thereto during any part of the preceding 12-month period ended September 30, and transmit it by the following January 31 of each year to the Chief, Air Traffic Division in the regional office of the Federal Aviation Administration having jurisdiction over the area in which the restricted area is located, with a copy to the Director, Air Traffic Service, Federal Aviation Administration, Washington, D.C. 20591.

(b) In the report under this section the using agency shall:

(1) State the name and number of the restricted area as published in this Part, and the period covered by the report.

(2) State the activities (including average daily number of operations if appropriate) conducted in the area, and any other pertinent information concerning current and future electronic monitoring devices.

(3) State the number of hours daily, the days of the week, and the number of weeks during the year that the area was used.

(4) For restricted areas having a joint-use designation, also state the number of hours daily, the days of the week, and the number of weeks during the year that the restricted area was released to the controlling agency for public use.

(5) State the mean sea level altitudes or flight levels (whichever is appropriate) used in aircraft operations and the maximum and average ordinate of surface firing (expressed in feet, mean sea level altitude) used on a daily, weekly, and yearly basis.

(6) Include a chart of the area (of optional scale and design) depicting, if used, aircraft operating areas, flight patterns, ordinance delivery areas, surface firing points, and target, fan, and impact areas. After once submitting an appropriate chart, subsequent annual charts are not required unless there is a change in the area, activity or altitude (or flight levels) used, which might alter the depiction of the activities originally reported. If no change is to be submitted, a statement indicating "no change" shall be included in the report.

(7) Include any other information not otherwise required under this Part which is considered pertinent to activities carried on in the restricted area.

(c) If it is determined that the information submitted under paragraph (b) of this section is not sufficient to evaluate the nature and extent of the use of a restricted area, the FAA may request the using agency to submit supplementary reports. Within 60 days after receiving a request for additional information, the using agency shall submit such information as the Director of the Air Traffic Service considers appropriate. Supplementary reports must be sent to the FAA officials designated in paragraph (a) of this section.

73.21 through 73.72 Redesignations.

608.21 through 608.72 of the Regulations of the Administrator are hereby redesignated as 73.21 through 73.72, respectively.*

SUBPART C—PROHIBITED AREAS

73.81 Applicability.

This subpart designates prohibited areas and prescribes limitations on the operation of aircraft therein.

73.83 Restrictions.

No person may operate an aircraft within a prohibited area unless authorization has been granted by the using agency.

73.85 Using Agency.

For the purpose of this subpart, the using agency is the agency, organization or military command that established the requirement for the prohibited area.

73.87 through 73.99.*

These sections are reserved for descriptions of designated Prohibited Areas.

*The airspace descriptions in this Part and their subsequent changes are published in the Federal Register. Due to their complexity and length, they will not be included in this publication of Part 73.

PART 75—ESTABLISHMENT OF JET ROUTES AND AREA HIGH ROUTES

SUBPART A—GENERAL

75.1 Applicability.

The routes described in Subpart B of this Part between high altitude navigational aids or intersections of their signals, are designated as jet routes along which aircraft may be operated between 18,000 feet MSL and flight level 450, inclusive. The routes described in Subpart D of this Part are designated as area high routes.

75.11 Jet routes.

Each jet route designated in Subpart B of this Part consists of a direct course for navigating aircraft between 18,000 feet MSL and flight level 450, inclusive, between the navigational aids and intersections specified for that route.

75.13 Area high routes; control area designation.

(a) Each area high route designated in Subpart D of this Part consists of a direct course for navigating aircraft at altitudes between 18,000 feet MSL and flight level 450, inclusive, between the waypoints specified for that route.

(b) Unless otherwise specified, that airspace, on each side of an area high route, that has a lateral extent specified in 71.6 and that extends outside the continental control area, is designated as a control area.

75.17 Bearings; radials; miles.

(a) All bearings and radials in this Part are true and are applied from point of origin.

(b) Unless otherwise specified, all mileages in this Part are stated as nautical miles.

SUBPART B—JET ROUTES

75.100 Jet routes.*

602.100 of the Regulations of the Administrator is hereby redesignated as 75.100.

* The jet route descriptions in this Part and their subsequent changes are published in the Federal Register. Due to their complexity and length they will not be included in this publication of Part 75.

SUBPART C—RESERVED

SUBPART D—AREA HIGH ROUTES

75.400 Area high routes.**

The parts of airspace described below are designated as area high routes.

**The area high route descriptions in this Part and their subsequent changes are published in the Federal Register. Due to their complexity and length they will not be included in this publication of Part 75.

PART 91—GENERAL OPERATING AND FLIGHT RULES

SUBPART A—GENERAL

91.1 Applicability.

(a) Except as provided in paragraph (b) of this section, this Part prescribes rules governing the operation of aircraft (other than moored balloons, kites, unmanned rockets, and unmanned free balloons) within the United States.

(b) Each person operating a civil aircraft of U.S. registry outside of the Unites States shall—

(1) When over the high seas, comply with Annex 2 (Rules of the Air) to the Convention on International Civil Aviation and with 91.70(c) and 91.90 of Subpart B;

(2) When within a foreign country, comply with the regulations relating to the flight and maneuver of aircraft there in force;

(3) Except for 91.15(b), 91.17, 91.38, and 91.43, comply with Subparts A, C, and D of this Part so far as they are not inconsistent with applicable regulations of the foreign country where the aircraft is operated or Annex 2 to the Convention on International Civil Aviation; and

(4) When over the North Atlantic within airspace designated as Minimum Navigation Performance Specifications airspace, comply with 91.20.

(c) Annex 2 to the Convention on International Civil Aviation, Sixth Edition—September 1970, with amendments through Amendment 20 effective August 1976, to which reference is made in this Part is incorporated into this Part and made a part hereof as provided in 5 U.S.C. 552 and pursuant to 1 CFR Part 51. Annex 2 (including a complete historic file of changes thereto) is available for public inspection at the Rules Docket, AGC-24, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20391. In addition, Annex 2 may be purchased from the International Civil Aviation Organization (Attention: Distribution Officer), P.O. Box 400, Succursale; Place de L'Aviation Internationale, 1000 Sherbrooke Street West, Montreal, Quebec, Canada H3A 2R2.

91.3 Responsibility and authority of the pilot in command.

(a) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft.

(b) In an emergency requiring immediate action, the pilot in command may deviate from any rule of this subpart or of Subpart B to the extent required to meet that emergency.

(c) Each pilot in command who deviates from a rule under paragraph (b) of this section shall, upon the request of the Administrator, send a written report of that deviation to the Administrator.

91.5 Preflight action.

Each pilot in command shall, before beginning a flight, familiarize himself with all available information concerning that flight. This information must include:

(a) For a flight under IFR or a flight not in the vicinity of an airport, weather reports and forecasts, fuel requirements, alternatives available if the planned flight cannot be completed, and any known traffic delays of which he has been advised by ATC.

(b) For any flight, runway lengths at airports of intended use, and the following takeoff and landing distance information:

(1) For civil aircraft for which an approved airplane or rotorcraft flight manual containing takeoff and landing distance data is required, the takeoff and landing distance data contained therein; and

(2) For civil aircraft other than those specified in subparagraph (1) of this paragraph, other reliable information appropriate to the aircraft, relating to aircraft performance under expected values of airport elevation and runway slope, aircraft gross weight, and wind and temperature.

91.7 Flight crewmembers at stations.

(a) During takeoff and landing, and while en route, each required flight crewmember shall—

(1) Be at his station unless his absence is necessary in the performance of his duties in connection with the operation of the aircraft or in connection with his physiological needs; and

(2) Keep his seat belt fastened while at his station.

(b) After July 18, 1978, each required flight crewmember of a U.S. registered civil airplane shall, during takeoff and landing, keep the shoulder harness fastened while at his station. This paragraph does not apply if—

(1) The seat at the crewmember's station is not equipped with a shoulder harness; or

(2) The crewmember would be unable to perform his required duties with the shoulder harness fastened.

91.8 Prohibition against interference with crewmembers.

No person may assault, threaten, intimidate, or interfere with a crewmember in the performance of the crewmember's duties aboard an aircraft being operated.

SUBPART B—FLIGHT RULES

General

91.61 Applicability.

This subpart prescribes flight rules governing the operation of aircraft within the United States.

91.63 Waivers.

(a) The Administrator may issue a certificate of waiver authorizing the operation of aircraft in deviation of any rule of this subpart if he finds that the proposed operation can be safely conducted under the terms of that certificate of waiver.

(b) An application for a certificate of waiver under this section is made on a form and in a manner prescribed by the Administrator and may be submitted to any FAA office.

(c) A certificate of waiver is effective as specified in that certificate.

91.65 Operating near other aircraft.

(a) No person may operate an aircraft so close to another aircraft as to create a collision hazard.

(b) No person may operate an aircraft in formation flight except by arrangement with the pilot in command of each aircraft in the formation.

(c) No person may operate an aircraft, carrying passengers for hire, in formation flight.

(d) Unless otherwise authorized by ATC, no person operating an aircraft may operate his aircraft in accordance with any clearance or instruction that has been issued to the pilot of another aircraft for radar Air Traffic Control purposes.

91.67 Right-of-way rules; except water operations

(a) General. When weather conditions permit, regardless of whether an operation is conducted under Instrument Flight Rules or Visual Flight Rules, vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft in compliance with this section. When a rule of this section gives another aircraft the right of way, he shall give way to that aircraft and may not pass over, under, or ahead of it, unless well clear.

(b) In distress. An aircraft in distress has the right of way over all other air traffic.

(c) Converging. When aircraft of the same category are converging at approximately the same altitude (except head-on, or nearly so) the aircraft to the other's right has the right of way. If the aircraft are of different categories—

(1) A balloon has the right of way over any other category of aircraft;

(2) A glider has the right of way over an airship, airplane or rotorcraft; and

(3) An airship has the right of way over an airplane or rotorcraft. However, an aircraft towing or refueling other aircraft has the right of way over all other engine-driven aircraft.

(d) Approaching head-on. When aircraft are approaching each other head-on, or nearly so, each pilot of each aircraft shall alter course to the right.

(e) Overtaking. Each aircraft that is being overtaken has the right of way and each pilot of an overtaking aircraft shall alter course to the right to pass well clear.

(f) Landing. Aircraft, while on final approach to land, or while landing, have the right of way over other aircraft in flight or operating on the surface. When two or more aircraft are approaching an airport for the purpose of landing, the aircraft at the lower altitude has the right of way, but it shall not take advantage of this rule to cut in front of another which is on final approach to land, or to overtake that aircraft.

(g) Inapplicability. This section does not apply to the operation of an aircraft on water.

91.69 Right-of-way rules; water operations.

(a) General. Each person operating an aircraft on the water shall, insofar as possible, keep clear of all vessels and avoid impeding their navigation, and shall give way to any vessel or other aircraft that is given the right of way by any rule of this section.

(b) Crossing. When aircraft, or an aircraft and a vessel are on crossing courses, the aircraft or vessel to the other's right has the right of way.

(c) Approaching head-on. When aircraft, or an aircraft and a vessel, are approaching head-on or nearly so, each shall alter its course to the right to keep well clear.

(d) Overtaking. Each aircraft or vessel that is being overtaken has the right of way, and the one overtaking shall alter course to keep well clear.

(e) Special circumstances. When aircraft, or an aircraft and a vessel, approach so as to involve risk of collision, each aircraft or vessel shall proceed with careful regard to existing circumstances, including the limitations of the respective craft.

91.70 Aircraft speed.

(a) Unless otherwise authorized by the Administrator, no person may operate an aircraft below 10,000 feet MSL at an indicated airspeed of more than 250 knots (288 m.p.h.).

(b) Unless otherwise authorized or required by ATC, no person may operate an aircraft within an airport traffic area at an indicated airspeed of more than

(1) In the case of a reciprocating engine aircraft, 156 knots (180 m.p.h.); or

(2) In the case of a turbine-powered aircraft, 200 knots (230 m.p.h.).

Paragraph (b) does not apply to any operations within a Terminal Control Area. Such operations shall comply with paragraph (a) of this section.

(c) No person may operate an aircraft in the airspace underlying a terminal control area, or in a VFR corridor designated through a terminal control area, at an indicated airspeed of more than 200 knots (230 m.p.h.). However, if the minimum safe airspeed for any particular operation is greater than the maximum speed prescribed in this section, the aircraft may be operated at that minimum speed.

91.71 Acrobatic flight.

No person may operate an aircraft in acrobatic flight—

(a) Over any congested area of a city, town, or settlement:

(b) Over an open air assembly of persons;

(c) Within a control zone or Federal airway;

(d) Below an altitude of 1,500 feet above the surface; or

(e) When flight visibility is less than three miles.

For the purposes of this section, acrobatic flight means an intentional maneuver involving an abrupt change in an aircraft's attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight.

91.73 Aircraft lights.

No person may, during the period from sunset to sunrise (or, in Alaska, during the period a prominent unlighted object cannot be seen from a distance of three statute miles or the sun is more than six degrees below the horizon)—

(a) Operate an aircraft unless it has lighted position lights;

(b) Park or move an aircraft in, or in dangerous proximity to, a night flight operations area of an airport unless the aircraft—

(1) Is clearly illuminated;

(2) Has lighted position lights; or

(3) Is in an area which is marked by obstruction lights.

(c) Anchor an aircraft unless the aircraft—

(1) Has lighted anchor lights; or

(2) Is in an area where anchor lights are not required on vessels; or

(d) Operate an aircraft, required by 91.33(c)(3) to be equipped with an anticollision light system, unless it has approved and lighted aviation red or aviation white anticollision lights. However, the anticollision lights need not be lighted when the pilot in command determines that, because of operating conditions, it would be in the interest of safety to turn the lights off.

91.75 Compliance with ATC clearances and instructions.

(a) When an ATC clearance has been obtained, no pilot in command may deviate from that clearance, except in an emergency, unless he obtains an amended clearance. However, except in positive controlled airspace, this paragraph does not prohibit him from cancelling an IFR flight plan if he is operating in VFR weather conditions. If a pilot is certain of the meaning of an ATC clearance, he shall immediately request clarification from ATC.

(b) Except in an emergency, no person may, in an area in which air traffic control is exercised, operate an aircraft contrary to an ATC instruction.

(c) Each pilot in command who deviates, in an emergency, from an ATC clearance or instruction shall notify ATC of that deviation as soon as possible.

(d) Each pilot in command who (though not deviating from a rule of this subpart) is given priority by ATC in an emergency, shall, if requested by ATC, submit a detailed report of that emergency within 48 hours to the chief of that ATC facility.

91.77 ATC light signals.

ATC light signals have the meaning shown in table D-1.

Table D-1.—ATC Light Signals

Color and type of signal	Meaning with respect to aircraft on the surface	Meaning with respect to aircraft in flight
Steady green	Cleared for takeoff	Cleared to land
Flashing green	Cleared to taxi	Return for landing (to be followed by steady green at proper time).
Steady red	Stop	Give way to other aircraft and continue circling.
Flashing red	Taxi clear of runway in use.	Airport unsafe—do not land.
Flashing white	Return to starting point on airport.	Not applicable.
Alternating red and green.	Exercise extreme caution.	Exercise extreme caution.

91.79 Minimum safe altitudes; general.

Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:

(a) Anywhere. An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.

(b) Over congested areas. Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft.

(c) Over other than congested areas. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In that case, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.

(d) Helicopters. Helicopters may be operated at less than the minimums prescribed in paragraph (b) or (c) of this section if the operation is conducted without hazard to persons or property on the surface. In addition, each person operating a helicopter shall comply with routes or altitudes specifically prescribed for helicopters by the Administrator.

91.81 Altimeter settings.

(a) Each person operating an aircraft shall maintain the cruising altitude or flight level of that aircraft, as the case may be, by reference to an altimeter that is set, when operating—

(1) Below 18,000 feet MSL, to—

(i) The current reported altimeter setting of a station along the route and within 100 nautical miles of the aircraft;

(ii) If there is no station within the area prescribed in subdivision (i) of this subparagraph, the current reported altimeter setting of an appropriate available station; or

(iii) In the case of an aircraft not equipped with a radio, the elevation of the departure airport or an appropriate altimeter setting available before departure; or

(2) At or above 18,000 feet MSL, to 29.92" Hg.

(b) The lowest usable flight level is determined by the atmospheric pressure in the area of operation, as shown in the following listing:

Current altimeter setting	Lowest usable flight level
29.92 (or higher)	180
29.91 thru 29.42	185
29.41 thru 28.92	190
28.91 thru 28.42	195
28.41 thru 27.92	200
27.91 thru 27.42	205
27.41 thru 26.92	210

(c) To convert minimum altitude prescribed under 91.79 and 91.119 to the minimum flight level, the pilot shall take the flight-level equivalent of the minimum altitude in feet and add the appropriate number of feet specified below, according to the current reported altimeter setting:

Current altimeter setting	Adjustment factor
29.92 (or higher)	None
29.91 thru 29.42	500 feet
29.41 thru 28.92	1000 feet
28.91 thru 28.42	1500 feet
28.41 thru 27.92	2000 feet
27.91 thru 27.42	2500 feet
27.41 thru 26.92	3000 feet

91.83 Flight plan; information required.

(a) Unless otherwise authorized by ATC, each person filing an IFR or VFR flight plan shall include in it the following information:

(1) The aircraft identification number and, if necessary, its radio call sign

(2) The type of the aircraft or, in the case of a formation flight, the type of each aircraft and the number of aircraft, in the formation

(3) The full name and address of the pilot in command or, in the case of a formation flight, the formation commander

(4) The point and proposed time of departure

(5) The proposed route, cruising altitude (or flight level), and true airspeed at that altitude

(6) The point of first intended landing and the estimated elapsed time until over that point

(7) The radio frequencies to be used

(8) The amount of fuel on board (in hours)

(9) In the case of an IFR flight plan, an alternate airport, except as provided in paragraph (b) of this section

(10) The number of persons in the aircraft, except where that information is otherwise readily available to the FAA

(11) Any other information the pilot in command or ATC believes is necessary for ATC purposes.

91.85 Operating on or in the vicinity of an airport; general rules.

(a) Unless otherwise required by Part 93 of this chapter, each person operating an aircraft on or in the vicinity of an airport shall comply with the requirements of this section and of 91.87 and 91.89.

(b) Unless otherwise authorized or required by ATC, no person may operate an aircraft within an airport traffic area except for the purpose of landing at, or taking off from, an airport within that area. ATC authorizations may be given as individual approval of specific operations or may be contained in written agreements between airport users and the tower concerned.

(c) After March 28, 1977, except when necessary for training or certification, the pilot in command of a civil turbojet-powered airplane shall use, as a final landing flap setting, the minimum certificated landing flap setting appearing in the approved performance information in the Airplane Flight Manual for the applicable conditions. However, each pilot in command has the final authority and responsibility for the safe operation of his airplane, and he may use a different flap setting approved for that airplane if he determines that it is necessary in the interest of safety.

91.87 Operation at airports with operating control towers.

(a) General. Unless otherwise authorized or required by ATC, each person operating an aircraft to, from, or on an airport with an operating control tower shall comply with the applicable provisions of this section.

(b) Communications with control towers operated by the United States. No person may, within an airport traffic area, operate an aircraft to, from, or on an airport having a control tower operated by the United States unless two-way radio communications are maintained between that aircraft and the control tower. However, if the aircraft radio fails in flight, he may operate that aircraft and land if weather conditions are at or above basic VFR weather minimums, he maintains visual contact with the tower, and he receives a clearance to land. If the aircraft radio fails while in flight under IFR, he must comply with 91.127.

(c) Communications with other control towers. No person may, within an airport traffic area, operate an aircraft to, from, or on an airport having

a control tower that is operated by any person other than the United States unless—

(1) That aircraft's radio equipment so allows, two-way radio communications are maintained between the aircraft and the tower; or

(2) That aircraft's radio equipment allows only reception from the tower, the pilot has the tower's frequency monitored.

(d) Minimum altitudes. When operating to an airport with an operating control tower, each pilot of—

(1) A turbine-powered airplane or a large airplane shall, unless otherwise required by the applicable distance from cloud criteria, enter the airport traffic area at an altitude of at least 1,500 feet above the surface of the airport and maintain at least 1,500 feet within the airport traffic area, including the traffic pattern, until further descent is required for a safe landing;

(2) A turbine-powered airplane or a large airplane approaching to land on a runway being served by an ILS, shall, if the airplane is ILS equipped, fly that airplane at an altitude at or above the glide slope between the outer marker (or the point of interception with the glide slope, if compliance with the applicable distance from clouds criteria requires interception closer in) and the middle marker; and,

(3) An airplane approaching to land on a runway served by a visual approach slope indicator, shall maintain an altitude at or above the glide slope until a lower altitude is necessary for a safe landing. However, subparagraphs (2) and (3) of this paragraph do not prohibit normal bracketing maneuvers above or below the glide slope that are conducted for the purpose of remaining on the glide slope.

(e) Approaches. When approaching to land at an airport with an operating control tower, each pilot of—

(1) An airplane, shall circle the airport to the left; and

(2) A helicopter, shall avoid the flow of fixed-wing aircraft.

(f) Departure. No person may operate an aircraft taking off from an airport with an operating control tower except in compliance with the following:

(1) Each pilot shall comply with any departure procedures established for that airport by the FAA.

(2) Unless otherwise required by the departure procedure or the applicable distance from clouds criteria, each pilot of a turbine-powered airplane and each pilot of a large airplane shall climb to an altitude of 1,500 feet above the surface as rapidly as practicable.

(g) Noise abatement runway system. When landing or taking off from an airport with an operating control tower and for which a formal runway use program has been established by the FAA, each pilot of a turbine-powered airplane and each pilot of a large airplane, assigned a noise abatement runway by ATC, shall use that runway. However, consistent with the final authority of the pilot in command concerning the safe operation of the aircraft as prescribed in 91.3(a), ATC may assign a different runway if requested by the pilot in the interest of safety.

(h) Clearance required. No person may, at an airport with an operating tower, operate an aircraft on a runway or taxiway, or takeoff or land an aircraft, unless an appropriate clearance is received from ATC. A clearance to "taxi to" the takeoff runway assigned to the aircraft is not a clearance to cross that assigned takeoff runway, or to taxi on that runway at any point, but is a clearance to cross other runways that interest the taxi route to that assigned takeoff runway. A clearance to "taxi to" any point other than an assigned takeoff runway is a clearance to cross all runways that intersect the taxi route to that point.

91.89 Operation at airports without control towers.

Each person operating an aircraft to or from an airport without an operating control tower shall—

(a) In the case of an airplane approaching to land, make all turns of that airplane to the left unless the airport displays approved light signals or visual markings indicating that turns should be made to the right, in which case the pilot shall make all turns to the right;

(b) In the case of a helicopter approaching to land, avoid the flow of fixed-wing aircraft; and

(c) In the case of an aircraft departing the airport, comply with any FAA traffic pattern for that airport.

91.90 Terminal control areas.

(a) Group I terminal control areas.

(1) Operating rules. No person may operate an aircraft within a Group I terminal control area designated in Part 71 of this Chapter except in compliance with the following rules:

(i) No person may operate an aircraft within a Group I terminal control area unless he has received an appropriate authorization from ATC prior to the operation of that aircraft in that area.

(ii) Unless otherwise authorized by ATC, each person operating a large turbine engine powered airplane to or from a primary airport shall operate at or above the designated floors while within the lateral limits of the terminal control area.

(2) Pilot requirements. The pilot in command of a civil aircraft may not land or take off that aircraft from an airport within a Group I terminal control area unless he holds at least a private pilot certificate.

(3) Equipment requirements. Unless otherwise authorized by ATC in the case of in-flight VOR, TACAN, or two-way radio failure; or unless otherwise authorized by ATC in the case of a transponder failure occurring at any time, no person may operate an aircraft within a Group I terminal control area unless that aircraft is equipped with—

(i) An operable VOR or TACAN receiver (except in the case of helicopters);

(ii) An operable two-way radio capable of communicating with ATC on appropriate frequencies for that terminal control area; and

(iii) The applicable equipment specified in 91.24.

(b) Group II terminal control areas.

(1) Operating rules. No person may operate an aircraft within a Group II terminal control area designated in Part 71 of this chapter except in compliance with the following rules:

(i) No person may operate an aircraft within a Group II Terminal Control Area unless he has received an appropriate authorization from ATC prior to operation of that aircraft in that area, and unless two-way radio communications are maintained, within that area, between that aircraft and the ATC facility.

(ii) Unless otherwise authorized by ATC, each person operating a large turbine engine powered airplane to or from a primary airport shall operate at or above the designated floors while within the lateral limits of the terminal control area.

(2) Equipment requirements. Unless otherwise authorized by ATC in the case of in-flight VOR, TACAN, or two-way radio failure; or unless otherwise authorized by ATC in the case of a transponder failure occurring at any time, no person may operate an aircraft within a Group II terminal control area unless that aircraft is equipped with—

(i) An operable VOR or TACAN receiver (except in the case of helicopters);

(ii) An operable two-way radio capable of communicating with ATC on the appropriate frequencies for that terminal control area; and

(iii) The applicable equipment specified in 91.24, except that automatic pressure reporting equipment is not required for any operation within the terminal control area, and a transponder is not required for IFR flights operating to or from an airport outside of but in close proximity to the terminal control area, when the commonly used transition, approach, or departure procedures to such airport require flight within the terminal control area.

(c) Group III terminal control areas. No person may operate an aircraft within a Group III Terminal Control Area designated in Part 71 unless the applicable provisions of 91.24(b) are complied with, except that such compliance is not required if two-way radio communications are maintained, within the TCA, between the aircraft and the ATC facility, and the pilot provides position, altitude, and proposed flight path prior to entry.

91.91 Temporary flight restrictions.

(a) Whenever the Administrator determines it to be necessary in order to prevent an unsafe congestion of sight-seeing aircraft above an incident or event which may generate a high degree of public interest, or to provide a safe environment for the operation of disaster relief aircraft, a Notice to Airmen will be issued designating an area within which temporary flight restrictions apply.

(b) When a Notice to Airmen has been issued under this section, no person may operate an aircraft within the designated area unless—

(1) That aircraft is participating in disaster relief activities and is being operated under the direction of the agency responsible for relief activities;

(2) That aircraft is being operated to or from an airport within the area and is operated so as not to hamper or endanger relief activities;

(3) That operation is specifically authorized under an IFR ATC clearance;

(4) VFR flight around or above the area is impracticable due to weather, terrain, or other considerations, prior notice is given to the Air Traffic Service facility specified in the Notice to Airmen, and en route operation through the area is conducted so as not to hamper or endanger relief activities; or,

(5) That aircraft is carrying properly accredited news representatives, or persons on official business concerning the incident or event which generated the issuance of the Notice to Airmen; the operation is conducted in accordance with 91.79 of this chapter; the operation is conducted above the altitudes being used by relief aircraft unless otherwise authorized by the agency responsible for relief activities; and further, in connection with this type of operation, prior to entering the area the operator has filed with the Air Traffic Service facility specified in the Notice to Airmen a flight plan that includes the following information:

(i) Aircraft identification, type and color.

(ii) Radio communications frequencies to be used.

(iii) Proposed times of entry and exit of the designated area.

(iv) Name of news media or purpose of flight.

(v) Any other information deemed necessary by ATC.

91.93 Flight test areas.

No person may flight test an aircraft except over open water, or sparsely populated areas, having light air traffic.

91.95 Restricted and prohibited areas.

(a) No person may operate an aircraft within a restricted area (designated in Part 73) contrary to the restrictions imposed, or within a prohibited area, unless he has the permission of the using or controlling agency, as appropriate.

(b) Each person conducting, within a restricted area, an aircraft operation (approved by the using agency) that creates the same hazards as the operations for which the restricted area was designated, may deviate from the rules of this subpart that are not compatible with his operation of the aircraft.

91.97 Positive control areas and route segments.

(a) Except as provided in paragraph (b) of this section, no person may operate an aircraft within a positive control area or positive control route segment, designated in Part 71 of this chapter, unless that aircraft is—

(1) Operated under IFR at a specific flight level assigned by ATC;

(2) Equipped with instruments and equipment required for IFR operations;

(3) Flown by a pilot rated for instrument flight; and

(4) Equipped, when in a positive control area, with—

(i) The applicable equipment specified in 91.24; and

(ii) A radio providing direct pilot/controller communication on the frequency specified by ATC for the area concerned.

(b) ATC may authorize deviations from the requirements of paragraph (a) of this section for operation in a positive control area. In the case of an inoperative transponder, ATC may immediately approve an operation allowing flight to continue to the ultimate destination, including any intermediate stops, or to proceed to a place where suitable repairs can be made, or both. A request for authorization to deviate from a requirement of this section must be submitted at least four days before the proposed operation, in writing, to the ATC center having jurisdiction over the positive control area concerned. ATC may authorize deviations on a continuing basis or for an individual flight, as appropriate.

91.102 Flight limitation in the proximity of space flight recovery operations.

No person may operate any aircraft of United States registry, or pilot any aircraft under the authority of an airman certificate issued by the Federal Aviation Administration within areas designated in a Notice to Airmen (NOTAM) for space flight recovery operations except when authorized by ATC, or operated under the control of the Department of Defense Manager for Manned Space Flight Support Operations.

91.104 Flight restrictions in the proximity of the Presidential and other parties.

No person may operate an aircraft over or in the vicinity of any area to be visited or traveled by the President, the Vice President, or other public figures contrary to the restrictions established by the Administrator and published in a Notice to Airmen (NOTAM).

Visual Flight Rules

91.105 Basic VFR weather minimums.

(a) Except as provided in 91.107, no person may operate an aircraft under VFR when the flight visibility is less, or at a distance from clouds that is less, than that prescribed for the corresponding altitude as shown in table D-2.

(b) When the visibility is less than one mile, a helicopter may be operated outside controlled airspace at 1,200 feet or less above the surface if operated at a speed that allows the pilot adequate opportunity to see any air traffic or other obstruction in time to avoid a collision.

(c) Except as provided in 91.107, no person may operate an aircraft, under VFR, within a control zone beneath the ceiling when the ceiling is less than 1,000 feet.

(d) Except as provided in 91.107, no person may take off or land an aircraft, or enter the traffic pattern of an airport, under VFR, within a control zone—

(1) Unless ground visibility at that airport is at least three statute miles; or

(2) If ground visibility is not reported at that airport, unless flight visibility during landing or take off, or while operating in the traffic pattern, is at least three statute miles.

(e) For the purposes of this section, an aircraft operating at the base altitude of a transition area or control area is considered to be within the airspace directly below that area.

Table D-2.—Basic VFR Weather Minimums

Altitude	Flight visibility	Distance from clouds
1,200 feet or less above the surface (regardless of MSL altitude)—		
Within controlled airspace	3 statute miles	500 feet below. 1,000 feet above. 2,000 feet horizontal.
Outside controlled airspace	1 statute mile except as provided in § 91.105(b).	Clear of clouds.
More than 1,200 feet above the surface but less than 10,000 feet MSL—		
Within controlled airspace	3 statute miles	500 feet below. 1,000 feet above. 2,000 feet horizontal.
Outside controlled airspace	1 statute mile	500 feet below. 1,000 feet above. 2,000 feet horizontal.
More than 1,200 feet above the surface and at or above 10,000 feet MSL.	5 statute miles	1,000 feet below. 1,000 feet above. 1 mile horizontal.

91.107 Special VFR weather minimums.

(a) Except as provided in 93.113, when a person has received an appropriate ATC clearance, the special weather minimums of this section instead of those contained in 91.105 apply to the operation of an aircraft by that person in a control zone under VFR.

(b) No person may operate an aircraft in a control zone under VFR except clear of clouds.

(c) No person may operate an aircraft (other than a helicopter) in a control zone under VFR unless flight visibility is at least one statute mile.

(d) No person may take off or land an aircraft (other than a helicopter) at any airport in a control zone under VFR—

(1) Unless ground visibility at that airport is at least one statute mile; or

(2) If ground visibility is not reported at that airport, unless flight visibility during landing or takeoff is at least one statute mile.

(e) No person may operate an aircraft (other than a helicopter) in a control zone under the special weather minimums of this section, between sunset and sunrise (or in Alaska, when the sun is more than six degrees below the horizon) unless:

(1) That person meets the applicable requirements for instrument flight under Part 61 of this chapter; and

(2) The aircraft is equipped as required in 91.33(d).

91.109 VFR cruising altitude or flight level.

Except while holding in a holding pattern of 2 minutes or less, or while turning, each person operating an aircraft under VFR in level cruising flight more than 3,000 feet above the surface shall maintain the appropriate altitude or flight level prescribed below, unless otherwise authorized by ATC:

(a) When operating below 18,000 feet MSL and—

(1) On a magnetic course of zero degrees through 179 degrees, any odd thousand foot MSL altitude +500 feet (such as 3,500, 5,500, or 7,500); or

(2) On a magnetic course of 180 degrees through 359 degrees, any even thousand foot MSL altitude +500 feet (such as 4,500, 6,500, or 8,500).

(b) When operating above 18,000 feet MSL to flight level 290 (inclusive), and—

(1) On a magnetic course of zero degrees through 179 degrees, any odd flight level +500 feet (such as 195, 215, or 235); or

(2) On a magnetic course of 180 degrees through 359 degrees, any even flight level +500 feet (such as 185, 205, or 225).

(c) When operating above flight level 290 and—

(1) On a magnetic course of zero degrees through 179 degrees, any flight level, at 4,000-foot intervals, beginning at and including flight level 300 (such as flight level 300, 340, or 380); or

(2) On a magnetic course of 180 degrees through 359 degrees, any flight level, at 4,000-foot intervals, beginning at and including flight level 320 (such as flight level 320, 360, or 400).

Instrument Flight Rules

91.115 ATC clearance and flight plan required.

No person may operate an aircraft in controlled airspace under IFR unless—

(a) He has filed an IFR flight plan; and

(b) He has received an appropriate ATC clearance.

91.116 Takeoff and landing under IFR: general.

(a) Instrument approaches to civil airports. Unless otherwise authorized by the Administrator (including ATC), each person operating an aircraft shall, when an instrument letdown to an airport is necessary, use a standard instrument approach procedure prescribed for that airport in Part 97.

(b) Landing minimums. Unless otherwise authorized by the Administrator, no person operating an aircraft (except a military aircraft of the United States) may land that aircraft using a standard instrument approach procedure prescribed in Part 97 unless the visibility is at or above the landing minimum prescribed in that Part for the procedure used. If the landing minimum in a standard instrument approach procedure prescribed in Part 97 is stated in terms of ceiling and visibility, the visibility minimum applies. However, the ceiling minimum shall be added to the field elevation and that value observed as the MDA or DH, as appropriate to the procedure being executed.

(c) Civil airport takeoff minimums. Unless otherwise authorized by the Administrator, no person operating an aircraft under Part 121, 123, 129, or 135 may take off from a civil airport under IFR unless weather conditions are at or above the weather minimums for IFR takeoff prescribed for that airport in Part 97 of this chapter. If takeoff minimums are not prescribed in Part 97 for a particular airport, the following minimums apply to takeoffs under IFR for aircraft operating under those parts:

(1) Aircraft having two engines or less: 1 statute mile visibility.

(2) Aircraft having more than two engines: 1/2 statute mile visibility.

(d) Military airports. Unless otherwise prescribed by the Administrator, each person operating a civil aircraft under IFR into, or out of, a military airport shall comply with the instrument approach procedures and the takeoff and landing minimums prescribed by the military authority having jurisdiction on that airport.

(e) Comparable values of RVR and ground visibility.

(1) If RVR minimums for takeoff or landing are prescribed in an instrument approach procedure, but RVR is not reported for the runway of intended operation, the RVR minimum shall be converted to ground visibility in accordance with the table in subparagraph (2) of this paragraph and observed as the applicable visibility minimum for takeoff or landing on that runway.

(2) RVR	Visibility (statute miles)
1600 feet	1/4 mile
2400 feet	1/2 mile
3200 feet	5/8 mile
4000 feet	3/4 mile
4500 feet	7/8 mile
5000 feet	1 mile
6000 feet	1 1/4 mile

(f) Operation on unpublished routes and use of radar in instrument approach procedures. When radar is approved at certain locations for ATC purposes, it may be used not only for surveillance and precision radar approaches, as applicable, but also may be used in conjunction with instrument approach procedures predicated on other types of radio navigational aids. Radar vectors may be authorized to provide course guidance through the segments of an approach procedure to the final approach fix or position. When operating on an unpublished route or while being radar vectored, the pilot, when an approach clearance is received, shall, in addition to complying with 91.119, maintain his last assigned altitude (1) unless a different altitude is assigned by ATC, or (2) until the aircraft is established on a segment of a published route or instrument approach procedure. After the aircraft is so established, published altitudes apply to descent within each succeeding route or approach segment unless a different altitude is assigned by ATC. Upon reaching the final approach fix or position, the pilot may either complete his instrument approach in accordance with the procedure approved for the facility, or may continue a surveillance or precision radar approach to a landing.

(g) Use of low or medium frequency simultaneous radio ranges for ADF procedures. Low frequency or medium frequency simultaneous radio ranges may be used as an ADF instrument approach aid if an ADF procedure for the airport concerned is prescribed by the Administrator, or if an approach is conducted using the same course and altitudes for the ADF approach as those specified in the approved range procedures.

(h) Limitations on procedure turns. In the case of a radar initial approach to a final approach fix or position, or a timed approach from a holding fix, or where the procedure specifies "NOPT" or "FINAL", no pilot may make a procedure turn unless, when he receives his final approach clearance, he so advises ATC.

91.117 Limitations on use of instrument approach procedures (other than Category II).

(a) General. Unless otherwise authorized by the Administrator, each person operating an aircraft using an instrument approach procedure prescribed in Part 97 shall comply with the requirements of this section. This section does not apply to the use of Category II approach procedures.

(b) Descent below MDA or DH. No person may operate an aircraft below the prescribed minimum descent altitude or continue an approach below the decision height unless—

(1) The aircraft is in a position from which a normal approach to the runway of intended landing can be made; and

(2) The approach threshold of that runway, or approach lights or other markings identifiable with the approach end of that runway, are clearly visible to the pilot.

If, upon arrival at the missed approach point or decision height, or at any time thereafter, any of the above requirements are not met, the pilot shall immediately execute the appropriate missed approach procedure.

91.119 Minimum altitudes for IFR operations.

(a) Except when necessary for takeoff or landing, or unless otherwise authorized by the Administrator, no person may operate an aircraft under IFR below—

(1) The applicable minimum altitudes prescribed in Parts 95 and 97; or

(2) If no applicable minimum altitude is prescribed in those Parts—

(i) In the case of operations over an area designated as a mountainous area in Part 95, an altitude of 2,000 feet above the highest obstacle within a horizontal distance of five statute miles from the course to be flown; or

(ii) In any other case, an altitude of 1,000 feet above the highest obstacle within a horizontal distance of five statute miles from the course to be flown.

However, if both a MEA and a MOCA are prescribed for a particular route or route segment, a person may operate an aircraft below the MEA down to, but not below, the MOCA, when within 25 statute miles of the VOR concerned (based on the pilot's reasonable estimate of that distance).

(b) Climb. Climb to a higher minimum IFR altitude shall begin immediately after passing the point beyond which that minimum altitude applies, except that, when ground obstructions intervene, the point beyond which the higher minimum altitude applies shall be crossed at or above the applicable MCA.

91.121 IFR cruising altitude or flight level.

(a) In controlled airspace. Each person operating an aircraft under IFR in level cruising flight in controlled airspace shall maintain the altitude or flight level assigned that aircraft by ATC. However, if the ATC clearance assigns "VFR conditions-on-top," he shall maintain an altitude or flight level as prescribed by 91.109.

(b) In uncontrolled airspace. Except while holding in a holding pattern of two minutes or less, or while turning, each person operating an aircraft under IFR in level cruising flight, in uncontrolled airspace, shall maintain an appropriate altitude as follows:

(1) When operating below 18,000 feet MSL and—

(i) On a magnetic course of zero degrees through 179 degrees, any odd thousand foot MSL altitude (such as 3,000, 5,000, or 7,000); or

(ii) On a magnetic course of 180 degrees through 359 degrees, any even thousand foot MSL altitude (such as 2,000, 4,000, or 6,000).

(2) When operating at or above 18,000 feet MSL but below flight level 290, and—

(i) On a magnetic course of zero degrees through 179 degrees, any odd flight level (such as 190, 210, or 230); or

(ii) On a magnetic course of 180 degrees through 359 degrees, any even flight level (such as 180, 200, or 220).

(3) When operating at flight level 290 and above, and—

(i) On a magnetic course of zero degrees through 179 degrees, any flight level, at 4,000-foot intervals, beginning at and including flight level 290 (such as flight level 290, 330, or 370); or

(ii) On a magnetic course of 180 degrees through 359 degrees, any flight level, at 4,000-foot intervals, beginning at and including flight level 310 (such as flight level 310, 350, or 390).

91.123 Course to be flown.

Unless otherwise authorized by ATC, no person may operate an aircraft within controlled airspace, under IFR, except as follows:

(a) On a Federal airway, along the centerline of that airway.

(b) On any other route, along the direct course between the navigational aids or fixes defining that route.

However, this section does not prohibit maneuvering the aircraft to pass well clear of other air traffic or the maneuvering of the aircraft, in VFR conditions, to clear the intended flight path both before and during climb or descent.

91.125 IFR, radio communications.

The pilot in command of each aircraft operated under IFR in controlled airspace shall have a continuous watch maintained on the appropriate frequency and shall report by radio as soon as possible—

(a) The time and altitude of passing each designated reporting point, or the reporting points specified by ATC, except that while the aircraft is under radar control, only the passing of those reporting points specifically requested by ATC need be reported;

(b) Any unforecast weather conditions encountered; and

(c) Any other information relating to the safety of flight.

91.127 IFR operations; two-way radio communications failure.

(a) General. Unless otherwise authorized by ATC, each pilot who has two-way radio communications failure when operating under IFR shall comply with the rules of this section.

(b) VFR conditions. If the failure occurs in VFR conditions, or if VFR conditions are encountered after the failure, each pilot shall continue the flight under VFR and land as soon as practicable.

(c) IFR conditions. If the failure occurs in IFR conditions, or if paragraph (b) of this section cannot be complied with, each pilot shall continue the flight according to the following:

(1) Route.

(i) By the route assigned in the last ATC clearance received;

(ii) If being radar vectored, by the direct route from the point of radio failure to the fix, route, or airway specified in the vector clearance;

(iii) In the absence of an assigned route, by the route that ATC has advised may be expected in a further clearance; or

(iv) In the absence of an assigned route or a route that ATC has advised may be expected in a further clearance, by the route filed in the flight plan.

(2) Altitude. At the highest of the following altitudes or flight levels for the route segment being flown:

(i) The altitude or flight level assigned in the last ATC clearance received;

(ii) The minimum altitude (converted, if appropriate, to minimum flight level as prescribed in 91.81(c)) for IFR operations; or

(iii) The altitude or flight level ATC has advised may be expected in a further clearance.

(3) Revoked.

(4) Leave holding fix. If holding instructions have been received, leave the holding fix at the expect-further-clearance time received, or, if an expected approach clearance time has been received, leave the holding fix in order to arrive over the fix from which the approach begins as close as possible to the expected approach clearance time.

(5) Descent for approach. Begin descent from the en route altitude or flight level upon reaching the fix from which the approach begins, but not before—

(i) The expect-approach-clearance time (if received); or

(ii) If no expect-approach-clearance time has been received, at the estimated time of arrival, shown on the flight plan, as amended with ATC.

91.129 Operation under IFR in controlled airspace; malfunction reports.

(a) The pilot in command of each aircraft operated in controlled airspace under IFR, shall report immediately to ATC any of the following malfunctions of equipment occurring in flight:

(1) Loss of VOR, TACAN, ADF, or low frequency navigation receiver capability.

(2) Complete or partial loss of ILS receiver capability.

(3) Impairment of air/ground communications capability.

(b) In each report required by paragraph (a) of this section, the pilot in command shall include the—

(1) Aircraft identification;

(2) Equipment affected;

(3) Degree to which the capability of the pilot to operate under IFR in the ATC system is impaired; and

(4) Nature and extent of assistance he desires from ATC.

PART 95—IFR ALTITUDES

Terms used in IFR altitudes are as follows:

(a) This part prescribes altitudes governing the operation of aircraft under IFR on Federal airways, jet routes, or other direct routes for which an MEA is designated in this part. In addition, it designates mountainous areas and changeover points (not included in this training manual).

(b) The MAA is the highest altitude on a Federal airway, jet route, or other direct route for which an MEA is designated in this part at which adequate reception of navigation aid signals is assured.

(c) The MCA applies to the operation of an aircraft proceeding to a higher minimum en route altitude when crossing specified radio fixes.

(d) The MEA prescribed for a Federal airway or segment thereof, applies to the entire width of that airway or segment between the radio fixes defining that airway or segment. An MEA prescribed for an off-airway route or route segment applies to the airspace 5 statute miles on each side of a direct course between radio fixes defining that route or route segment. The MEA in effect between fixes assures navigation signal reception and obstruction clearance between those fixes.

(e) The MOCA applies to the operation of an aircraft within 25 statute miles of the VOR station concerned. The MOCA assures obstruction clearance between the fixes specified but adequate reception of navigational signals is assured only within 25 miles of the VOR station concerned.

(f) The MRA applies to the operation of an aircraft over an intersection used in the navigation of that aircraft. The MRA is the lowest altitude at which the intersection can be determined.

(g) The COP (changeover point) applies to operation of an aircraft along a Federal airway, jet route, or other direct route for which an MEA is designated in this part. It is the most appropriate point for transfer of the airborne navigation reference between the facility abaft the aircraft and the next appropriate facility along the Federal airway, jet route, or other direct route that provides:

(1) Continuous reception between facilities; and

(2) A common source of azimuth guidance for all aircraft operating along the same segment of the Federal airway, jet route, or direct route. Unless otherwise specified, the COP is midway between the navigation facilities for straight route segments, or at the intersection of radials forming a dogleg in the case of dogleg route segments.

PART 99—SECURITY CONTROL OF AIR TRAFFIC

99.1 Applicability

(a) This subpart prescribes rules for operating civil aircraft in a defense area, or into, within, or out of the United States through an Air Defense Identification Zone (ADIZ).

(b) Except for 99.7, this subpart does not apply to the operation of an aircraft—

(1) In a Coastal or Domestic ADIZ north of 25 degrees north latitude or west of 85 degrees west longitude at a true airspeed of less than 180 knots;

(2) In the Alaskan DEWIZ at a true airspeed of less than 180 knots while the pilot maintains a continuous listening watch on the appropriate frequency;

(3) From any point in the 48 contiguous States on an outbound track through the Southern Border ADIZ that does not penetrate a Coastal ADIZ;

(4) Within the 48 contiguous States and the District of Columbia, or within the State of Alaska, which remains within 10 nautical miles of the point of departure; or

(5) Over any island, or within three nautical miles of the coastline of any island, in the Hawaiian ADIZ.

(c) Except as provided in 99.7, the radio and position reporting requirements of this subpart do not apply to the operation of an aircraft within the 48 contiguous States and the District of Columbia, or within the State of Alaska, if that aircraft does not have two-way radio and is operated in accordance with a filed DVFR flight plan containing the time and point of Domestic or Coastal ADIZ penetration and that aircraft departs within 5 minutes of the estimated departure time contained in the flight plan.

(d) An FAA ATC center may exempt the following operations from this subpart (except 99.7), on a local basis only, with the concurrence of the military commanders concerned:

(1) Aircraft operations that are conducted wholly within the boundaries of an ADIZ and are not currently significant to the air defense system.

(2) Aircraft operations conducted in accordance with special procedures prescribed by the military authorities concerned.

99.3 General

(a) Air defense identification zones (ADIZs) are areas of airspace over land or water in which the ready identification, location, and control of civil aircraft is required in the interest of national security. (See figure 2-13 in Chapter 2.) The are classified as—

(1) Coastal air defense identification zones (Coastal ADIZs);

(2) Domestic air defense identification zones (Domestic ADIZs); and

(3) Distant early warning identification zones (DEWIZs).

(b) Unless designated as an ADIZ, a Defense Area is any airspace of the United States in which the control of aircraft is required for national security.

(c) For the purpose of this Part, a Defense Visual Flight Rules (DVFR) flight is a flight within an ADIZ conducted under the visual flight rules in Part 91.

99.5 Emergency situations

In an emergency that requires immediate decision and action for the safety of the flight, the pilot in command of an aircraft may deviate from the rules in this Part to the extent required by that emergency. He shall report the reasons for the deviation to the communications facility where flight plans or positions reports are normally filed (referred to in this Part as "an appropriate aeronautical facility") as soon as possible.

99.7 Special security instructions

Each person operating an aircraft in an ADIZ or Defense Area shall, in addition to the applicable operating rules of this Part, comply with special security instructions issued by the Administrator in the interest of national security and that are consistent with appropriate agreements between the FAA and Department of Defense.

99.9 Radio requirements

No person may operate an aircraft in an ADIZ unless the aircraft has a functioning two-way radio.

99.11 Flight plan requirements

(a) No person may operate an aircraft in or penetrating a Coastal or Domestic ADIZ unless he has filed a flight plan with an appropriate aeronautical facility.

(b) Unless ATC authorizes an abbreviated flight plan—

(1) A flight plan for IFR flight must contain the information specified in 91.83; and

(2) A flight plan for VFR flight must contain the information specified in 91.83(a) (1) through (7).

(c) The pilot shall designate a flight plan for VFR flight as a DVFR flight plan.

DEWIZ

(a) No person may operate an aircraft in or penetrating a DEWIZ unless he has filed a flight plan before takeoff with an appropriate aeronautical facility. If there is no facility for filing a DVFR flight plan, the pilot must comply with 99.25(a)(2) and proceed according to the instructions issued by the appropriate aeronautical facility. These instructions normally require the flight to proceed to a specific area for visual identification or to land at a stated location.

(b) Unless ATC authorizes an abbreviated flight plan—

(1) A flight plan for IFR flight must contain the information specified in 91.83 and the estimated time and point of DEWIZ penetration (ETDP); and

(2) A flight plan for VFR flight must contain the information in 91.83(a)(1) through (7) and the estimated time and point of DEWIZ penetration (ETDP).

(c) The pilot shall designate a flight plan for VFR flight as a DVFR flight plan.

99.17 Position reports

The pilot of an aircraft operating in or penetrating a Domestic ADIZ under IFR—

(a) In controlled airspace, shall make the position reports required in 91.125; and

(b) In uncontrolled airspace, shall make the position reports required in 99.19.

99.19 Position Reports; Aircraft Operating in or Penetrating a Domestic ADIZ; DVFR.

No pilot may penetrate a Domestic ADIZ under DVFR unless—

(a) He reports to an appropriate aeronautical facility before penetration. The time, position, and altitude at which the aircraft passed the last reporting point before penetrating and the estimated time of arrival over the next appropriate reporting point along the flight route;

(b) If there is no appropriate reporting point along the flight route, he reports at least 15 minutes before penetration; the estimated time, position, and altitude at which he will penetrate; or

(c) If the airport of departure is so close to the Domestic ADIZ boundary that it prevents his complying with paragraphs (a) or (b) of this section, he has reported immediately after taking off: The time of departure, altitude, and estimated time of arrival over the first reporting point along the flight route.

The pilot of an aircraft entering the United States through a Coastal ADIZ shall make the reports required in 99.17 or 99.19 to an appropriate aeronautical facility.

In addition to such other reports as ATC may require, no pilot in command of a foreign civil aircraft may enter the United States through a Coastal ADIZ unless he makes the reports required in 99.17 or 99.19 or reports the position of the aircraft when it is not less than 1 hour and not more than 2 hours average direct cruising distance from the United States.

99.25 Position reports, aircraft entering the United States through a DEWIZ.

(a) The pilot of an aircraft entering the United States through a DEWIZ—

(1) If under IFR, shall report his position as required by 91.125; or

(2) If under DVFR, shall report when within radio range of an appropriate aeronautical facility but before penetration: The time, altitude, and position at which he passed the last reporting point and the estimated time, altitude and point of penetration.

(b) If requested, the pilot of an aircraft entering the United States through a DEWIZ shall advise an appropriate aeronautical facility of the difference between the actual time and point of penetration and the same data recorded in the original ground filed flight plan.

99.27 Deviation from flight plans and ATC clearances

(a) No pilot may deviate from the provisions of an ATC clearance or ATC instruction except in accordance with 91.75 of this chapter.

(b) No pilot may deviate from his filed IFR flight plan when operating an aircraft in uncontrolled airspace unless he notifies an appropriate aeronautical facility before deviating.

(c) No pilot may deviate from his filed DVFR flight plan unless he notifies an appropriate aeronautical facility before deviating.

99.29 Radio failure

If the pilot operating an aircraft under DVFR in an ADIZ cannot maintain two-way radio communications, he may proceed in accordance with his original DVFR flight plan or land as soon as practicable. The pilot shall report the radio failure to an appropriate aeronautical facility as soon as possible.

If a pilot operating an aircraft under IFR in an ADIZ cannot maintain two-way radio communications, he shall proceed in accordance with 91.127 of this chapter.

APPENDIX E

JOINT ELECTRONICS TYPE DESIGNATION SYSTEM

Set Indicator Letters					
1st letter (designed installation classes)	2d letter (type of equipment)	3d letter (purpose)	Model No.	Modification letter	Miscellaneous identification
Installation	Type of Equipment	Purpose			
A-Piloted aircraft.	A-Invisible light, heat radiation.	A-Auxiliary assemblies (not complete operating sets used with or part of two or more sets or sets series).	1	A	X-Changes in.
B-Underwater mobile, submarine.	C-Carrier.	B-Bombing.	2	B	Y-Voltage.
C-Air transportable (inactivated, do not use).	D-Radiac.	C-Communications (receiving and transmitting).	3	C	Z-Phase or frequency.
D-Pilotless carrier.	E-Nupac.	D-Direction finder, reconnaissance, and/or surveillance.	4, etc.	D, etc.	T-Training.
F-Fixed ground.	F-Photographic.	E-Ejection and/or release.			(V)-Variable grouping.
G-Ground, general ground use.	G-Telegraph or teletype.	G-Fire control or searchlight directing.			
K-Amphibious.	I-Interphone and public address.	H-Recording and/or reproducing (graphic, meteorological and sound).			
M-Ground, mobile.	J-Electromechanical or inertial wire covered.				
P-Portable.	K-Telemetering.				
S-Water surface.	L-Countermeasures.				

JOINT ELECTRONICS TYPE DESIGNATION SYSTEM—Continued

Set Indicator Letters			Model No.	Modification letter	Miscellaneous identification
1st letter (designed installation classes)	2d letter (type of equipment)	3d letter (purpose)			
Installation	Type of Equipment	Purpose			
T-Ground, transportable.	M-Meteorological.	K-Computing.			
U-General utility.	N-Sound in air.				
V-Ground, vehicular.	P-Radar.				
W-Water surface and underwater combination.	Q-Sonar and underwater sound.	M-Maintenance and test assemblies (including tools).			
	R-Radio.				
	S-Special types, magnetic, etc., or combinations of types.	N-Navigational aids (including altimeters, beacons, compasses, racons, depth sounding, approach, and landing).			
	T-Telephone (wire).				
	V-Visual and visible light.	Q-Special or combination of purposes.			
	W-Armament (peculiar to armament, not otherwise covered).	R-Receiving, passive detecting.			
	X-Facsimile or television.	S-Detecting and/or range and bearing, search.			
	Y-Data processing.	T-Transmitting.			
		W-Automatic flight or remote control.			
		X-Identification and recognition.			

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AIR TRAFFIC CONTROLLER 3 & 2

NAVEDTRA 10367-G

Prepared by the Naval Education and Training Program Development Center, Pensacola, Florida

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Your NRCC contains a set of assignments and perforated answer sheets. The Rate Training Manual, Air Traffic Controller 3 & 2 NAVEDTRA 10367-G, is your textbook for the NRCC. If an errata sheet comes with the NRCC, make all indicated changes or corrections. Do not change or correct the textbook or assignments in any other way.

HOW TO COMPLETE THIS COURSE SUCCESSFULLY

Study the textbook pages given at the beginning of each assignment before trying to answer the items. Pay attention to tables and illustrations as they contain a lot of information. Making your own drawings can help you understand the subject matter. Also, read the learning objectives that precede the sets of items. The learning objectives and items are based on the subject matter or study material in the textbook. The objectives tell you what you should be able to do by studying assigned textual material and answering the items.

At this point you should be ready to answer the items in the assignment. Read each item carefully. Select the BEST ANSWER for each item, consulting your textbook when necessary. Be sure to select the BEST ANSWER from the subject matter in the textbook. You may discuss difficult points in the course with others. However, the answer you select must be your own. Remove a perforated answer sheet from the back of this text, write in the proper assignment number, and enter your answer for each item.

Your NRCC will be administered by your command or, in the case of small commands, by the Naval Education and Training Program Development Center. No matter who administers your course you can complete it successfully by earning a 3.2 for each assignment. The unit breakdown of the course, if any, is shown later under Naval Reserve Retirement Credit.

WHEN YOUR COURSE IS ADMINISTERED BY LOCAL COMMAND

As soon as you have finished an assignment, submit the completed answer sheet to the officer designated to grade it. The graded answer sheet will not be returned to you.

If you are completing this NRCC to become eligible to take the fleetwide advancement examination, follow a schedule that will enable you to complete all assignments in time. Your schedule should call for the completion of at least one assignment per month.

Although you complete the course successfully, the Naval Education and Training Program Development Center will not issue you a letter of satisfactory completion. Your command will make an entry in your service record, giving you credit for your work.

WHEN YOUR COURSE IS ADMINISTERED BY THE NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER

After finishing an assignment, go on to the next. Retain each completed answer sheet until you finish all the assignments in a unit (or in the course if it is not divided into units). Using the envelopes provided, mail your completed answer sheets to the Naval Education and Training Program Development Center where they will be graded and the score recorded. Make sure all blanks at the top of each answer sheet are filled in. Unless you furnish all the information required, it will be impossible to give you credit for your work. The graded answer sheets will not be returned.

The Naval Education and Training Program Development Center will issue a letter of satisfactory completion to certify successful completion of the course (or a creditable unit of the course). To receive a course-completion letter, follow the directions given on the course-completion form in the back of this NRCC.

You may keep the textbook and assignments for this course. Return them <u>only</u> in the event you disenroll from the course or otherwise fail to complete the course. Directions for returning the textbook and assignments are given on the book-return form in the back of this NRCC.

PREPARING FOR YOUR ADVANCEMENT EXAMINATION

Your examination for advancement is based on the Occupational Standards for your rating as found in the MANUAL OF NAVY ENLISTED MANPOWER AND PERSONNEL CLASSIFICATIONS AND OCCUPATIONAL STANDARDS (NAVPERS 18068). These Occupational Standards define the minimum tasks required of your rating. The sources of questions in your advancement examination are listed in the BIBLIOGRAPHY FOR ADVANCEMENT STUDY (NAVEDTRA 10052). For your convenience, the Occupational Standards and the sources of questions for your rating are combined in a single pamphlet for the series of examinations for each year. These OCCUPATIONAL STANDARDS AND BIBLIOGRAPHY SHEETS (called Bib Sheets), are available from your ESO. Since your textbook and NRCC are among the sources listed in the bibliography, be sure to study both as you take the course. The qualifications for your rating may have changed since your course and textbook were printed, so refer to the latest edition of the Bib Sheets.

NAVAL RESERVE RETIREMENT CREDIT

This course is evaluated at 35 Naval Reserve retirement points. These points are creditable to personnel eligible to receive them under current directives governing retirement of Naval Reserve personnel. Points will be credited upon satisfactory completion of the course in units as follows:

Unit 1: 12 points upon completion of Assignments 1 through 5
Unit 2: 12 points upon completion of Assignments 6 through 10
Unit 3: 11 points upon completion of Assignments 11 through 14.

Naval Reserve retirement credit will not be given if the student has previously received credit for any Air Traffic Controller 3 & 2 NRCC.

COURSE OBJECTIVE

While completing this nonresident career course, the student will demonstrate an understanding of course materials by correctly answering items on the following areas: The air traffic controller rating; Federal Aviation Regulations; meteorological elements, weather reports, forecasts, and advisories; aircraft performance and characteristics; air navigation and aids to air navigation; flight assistance services; airport lighting, markings, and equipment; air traffic control communications; control tower equipment and operations; radar principles and allied equipment; radar operations; IFR/SWFR operations; and carrier air traffic control procedures.

While working on this correspondence course, you may refer freely to the text. You may seek advice and instruction from others on problems arising in the course, but the solutions submitted must be the result of your own work and decisions. You are prohibited from referring to or copying the solutions of others, or giving completed solutions to anyone else taking the same course.

Naval courses may include a variety of questions -- multiple-choice, true-false, matching, etc. The questions are not grouped by type; regardless of type, they are presented in the same general sequence as the textbook material upon which they are based. This presentation is designed to preserve continuity of thought, permitting step-by-step development of ideas. Some courses use many types of questions, others only a few. The student can readily identify the type of each question (and the action required) through inspection of the samples given below.

MULTIPLE-CHOICE QUESTIONS

Each question contains several alternatives, one of which provides the best answer to the question. Select the best alternative, and blacken the appropriate box on the answer sheet.

SAMPLE

s-1. The first person to be appointed Secretary of Defense under the National Security Act of 1947 was
1. George Marshall
2. James Forrestal
3. Chester Nimitz
4. William Halsey

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-1	□	■	□	□	___

TRUE-FALSE QUESTIONS

Mark each statement true or false as indicated below. If any part of the statement is false the statement is to be considered false. Make the decision, and blacken the appropriate box on the answer sheet.

SAMPLE

s-2. Any naval officer is authorized to correspond officially with any systems command of the Department of the Navy without his commanding officer's endorsement.

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-2	□	■	□	□	___

MATCHING QUESTIONS

Each set of questions consists of two columns, each listing words, phrases or sentences. The task is to select the item in column B which is the best match for the item in column A that is being considered. Items in column B may be used once, more than once, or not at all. Specific instructions are given with each set of questions. Select the numbers identifying the answers and blacken the appropriate boxes on the answer sheet.

SAMPLE

In questions s-3 through s-6, match the name of the shipboard officer in column A by selecting from column B the name of the department in which the officer functions.

A	B
s-3. Damage Control Assistant	1. Operations Department
s-4. CIC Officer	2. Engineering Department
s-5. Disbursing Officer	3. Supply Department
s-6. Communications Officer	

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-3	□	■	□	□	___
s-4	■	□	□	□	___
s-5	□	□	■	□	___
s-6	■	□	□	□	___

Assignment 1

ıffic Controller Rating and Federal Air Regulations

Pages 1-1 through 1-11

n this course you will demonstrate that learning has taken place by correctly answering ng items. The mere physical act of indicating a choice on an answer sheet is not in itself ant; it is the mental achievement, in whatever form it may take, prior to the physical act s important and toward which course learning objectives are directed. The selection of the t choice for a course training item indicates that you have fulfilled, at least in part, ated objective(s).

he accomplishment of certain objectives, for example, a physical act such as drafting a cannot readily be determined by means of objective type course items; however, you can trate by means of answers to training items that you have acquired the requisite knowledge form the physical act. The accomplishment of certain other learning objectives, for e, the mental acts of comparing, recognizing, evaluating, choosing, selecting, etc., may dily demonstrated in a course by indicating the correct answers to training items.

he comprehensive objective for this course has already been given. It states the purpose course in terms of what you will be able to do as you complete the course.

he detailed objectives in each assignment state what you should accomplish as you progress h the course. They may appear singly or in clusters of closely related objectives, as riate; they are followed by items which will enable you to indicate your accomplishment.

ll objectives in this course are learning objectives and items are teaching items. They out important things, they assist in learning, and they should enable you to do a better r the Navy.

'his self-study course is only one part of the total Navy training program; by its very it can take you only part of the way to a training goal. Practical experience, schools, ed reading, and the desire to accomplish are also necessary to round out a fully meaningful ng program.

Learning Objective: Recognize the AC rating as a general rating and identify the AC field entry requirements, its duties, and NECs.

The publication which delineates the minimum requirements for advancement is the

1. Naval Aeronautic Publications Index, NAVAIR 00-500
2. Bibliography for Advancement Study, NAVEDTRA 10052 (Series)
3. Manual of Navy Enlisted Manpower and Personnel Classification and Occupational Standards, NAVPERS 18068 (Series)
4. List of Rate Training Manuals and Correspondence Courses, NAVEDTRA 10061 (Series)

1-2. The purpose of the nonresident career course is to

1. assist the trainee in the training required to fulfill job requirements
2. supplement the text of the training manual
3. outline the career pattern for Air Traffic Controllers
4. review the occupational standards for Air Traffic Controllers

1-3. A general rating is one which reflects qualifications in

1. civilian skills identified with a peacetime Navy
2. civilian skills identified with a wartime Navy
3. subdivisions or specialties within broad occupational fields
4. broad occupational fields of related duties and functions

1-4. The rating structure for enlisted personnel in the AC rating provides for
1. a general rating only
2. two service ratings only
3. one general rating and two service ratings
4. two general ratings and one service rating

1-5. The Air Traffic Controller (AC) rating is included in Navy Occupational Field 7 (Air Traffic Control).

1-6. The primary mission of the AC is to control air traffic at airfields and on aircraft carriers.

1-7. AC3s and AC2s may be assigned the responsibility for performing which of the following functions?
1. Maintaining current flight planning information
2. Directing aircraft in all kinds of weather
3. Assisting pilots in preparing and processing flight plans and clearances
4. All of the above

1-8. In performing the duties of a Navy AC, individuals must comply with
1. Navy directives only
2. Federal Aviation Regulations (FARs) only
3. both Navy directives and Federal Aviation Regulations (FARs)
4. Federal Aviation Regulations (FARs) and FAA Handbook 7220.1

1-9. Which of the following requirements is NOT a prerequisite before an individual may enter the Air Traffic Controller rating?
1. Be in the AC-0000 NEC group
2. Be a graduate of the Naval Basic ATC Controller Course or have equivalent qualifications
3. Hold an FAA Second Class Medical Certificate
4. Possess at least an AC Form 8080-2

1-10. An AC assigned arrival, holding, and departure controller duties for aircraft conducting close air support missions within an amphibious objective area, is assigned to which of the following facilities?
1. FACSFAC
2. TACRON
3. OPAREA
4. NAVREP

1-11. The NEC codes supplement the enlisted rating structure by reflecting
1. an individual's rating
2. the most recent training that an individual has received
3. special knowledge and skills
4. all the Navy schools an individual has attended

In items 1-12 through 1-15, select from column B the Naval Enlisted Classification Code or Special Series Code assigned to the personnel in each category listed in column A.

	A. AC Categories	B. Codes
1-12.	A facility rated CATCC controller	1. AC-0000
		2. DG-9720
1-13.	A BMSN in training for AC	3. AC-6902
1-14.	An AC3 who is a certified control tower operator	4. AC-6999
1-15.	A BM3 in formal training for AC	

1-16. Which of the following statements about the assignment of NEC code AC-6901 is correct?
1. Graduation from the Navy's basic ATC course is a prerequisite
2. This NEC is assigned only after the controller has received a full facility rating at an approach control facility
3. This NEC is assigned for a nonradar approach control facility only
4. This NEC is assigned only after the controller has graduated from the basic ATC course and received a facility rating

1-17. Which of the following categories includes the NEC that would be assigned to an instructor in a Navy school?
1. Special series
2. Defense grouping
3. Entry series
4. Occupational area

Learning Objective: Identify Navy Air Traffic Controller certification and suspension/revocation procedures.

1-18. To be considered for the Air Traffic Controller rating, an applicant must pass a medical examination as prescribed by FAR, Part 67.

1-19. Air Traffic Controllers are required to possess a Third Class medical certificate.

1-20. What part of the FARs prescribes the certification procedures for all Air Traffic Controllers?

1. Part 65
2. Part 67
3. Part 75
4. Part 91

1-21. What OPNAV Instruction promulgates the applicability of Federal Aviation Regulation Part 65 and FAAH 7220.1, to Navy ACs?

1. 3271.1 (Series)
2. 3721.1 (Series)
3. 3722.2 (Series)
4. 3723.2 (Series)

1-22. In addition to the Airman Written Test Report, Navy personnel providing air traffic control services are required by the CNO to possess which of the following certificates?

1. AC Form 8060-1
2. AC Form 8080-2
3. FAA Form 7220-1
4. All of the above

1-23. The overall certification program for Air Traffic Controllers has how many parts?

1. 1
2. 2
3. 3
4. 4

1-24. The Airman Written Test Report (AC Form 8080-2) signifies that an Air Traffic Controller is fully qualified to perform the duties of a control tower operator at a particular airport.

1-25. The CTO facility rating is applicable to which of the following certificates?

1. AC Form 8060-1
2. AC Form 8080-2
3. FAA Form 7220-1
4. All of the above

1-26. An Air Traffic Control Specialist (ATCS) is identified by which of the following certificates?

1. CTO
2. AC Form 8060-1
3. AC Form 8080-2
4. FAA Form 7220-1

1-27. Qualification at all positions, including approach control, at a radar air traffic control facility is identified by which of the following facility ratings?

1. APC
2. FACSFAC
3. RATCF
4. TRACON

1-28. Which of the following facility ratings does NOT indicate an approach control qualification?

1. APC
2. RATCF
3. CATCC
4. TRACON

1-29. Which of the following facility ratings can be issued only at facilities specifically authorized by the CNO?

1. FCC
2. FOC
3. FSS
4. RFC

1-30. At a joint use facility where the FAA provides approach control service, a Navy controller who is qualified as a surveillance and/or precision radar final controller is assigned which of the following facility ratings?

1. APC
2. GCA
3. RFC
4. RATCF

1-31. As you progress in your training and become position qualified, you may then perform the duties of a controller at those positions without the direct and constant supervision of a qualified controller.

1-32. The FAA Regional Air Traffic Control Examiner may designate a Navy AC as the CTO Rating Examiner for a specific Naval Air Station. This Rating Examiner may administer CTO performance and facility rating examinations and endorse and issue permanent CTO certificates.

1-33. The certification of personnel within a control tower cab is the responsibility of the

1. ATCF Officer
2. Training and Standardization Supervisor
3. ATCS Examiner
4. FAA

In items 1-34 and 1-35, assume that you were issued a CTO certificate with rating under the rules of FAR, Part 65.

1-34. This certificate was issued for what length of time?
1. 1 year
2. 6 months
3. 90 days
4. Until surrendered, suspended, or revoked

1-35. The facility rating on this certificate is valid under which of the following conditions?
1. Until suspended or revoked
2. Until you transfer to a new duty station
3. As long as you meet the currency requirements of FAR, Part 65
4. All of the above

1-36. Which of the following cases would NOT be a cause for a/an CTO/ATCS Certificate(s) to be revoked?
1. A person's performance of ATC duties could adversely affect the facilities efficiency
2. A person's negligence caused an accident
3. A person has been medically diagnosed to have a character disorder
4. A person failed to obtain a facility rating within a specific time frame

1-37. What action is taken when a Navy controller appears to have contributed to an aircraft accident?
1. The controller's facility rating is immediately suspended
2. The controller's facility rating and certificate(s) are immediately suspended
3. The controller is temporarily relieved from operational duty and referred to a military flight surgeon for physical/psychological evaluation
4. The controller must make a written statement of the facts and then return to duty

1-38. If it has been determined by a full investigation that a Navy controller was responsible for an aircraft accident/incident, what action(s) must be taken as a minimum before the controller can return to operational duty?
1. There must be a detailed review of the accident/incident with the controller
2. The controller must be reevaluated and if needed, retrained on the operating position
3. The controller must demonstrate having the skill to perform ATC duties
4. All of the above

In items 1-39 through 1-42, select from column B the person(s) associated with the authorities listed in column A.

	A. Authority	B. Person(s)
1-39.	Suspend CTO rating	1. CNO only
1-40.	Suspend CTO certificate	2. FAA only
1-41.	Suspend or revoke RFC rating	3. CO or designated represen-tative
1-42.	Revoke ATCS certificate	
		4. CTO examiner

1-43. In addition to receiving an increased amount of pay, what are the personal benefits realized from advancement?
1. A feeling of accomplishment
2. Increased challenge and interesting job assignments
3. Increased respect from superiors and subordinates
4. All of the above

1-44. The AC3's or AC2's worth to the Navy is judged in part on the basis of the qualities of leadership displayed.

1-45. As you advance, your success is judged increasingly in terms of the
1. amount of work you do
2. technical experience you have acquired
3. number of different billets you fill
4. neatness and orderliness of the work areas for which you are responsible

1-46. How can you be sure that you are getting the latest professional information needed for advancement?

1. By learning where to look for accurate, authoritative up-to-date information on related subjects
2. By using only the latest revision of publications that are periodically revised
3. By ensuring that all official changes have been inserted in the pertinent publications requiring change insertion
4. By doing all of the above

Assignment 2

Federal Air Regulations

Text: Pages 2-1 through 2-34

Learning Objective: Recognize those portions of FAR 65 applicable to the issuance of air traffic control tower certificates or facility ratings and the application of those regulations governing the exercise of privileges of the basic certification or facility rating.

2-1. In interpreting the FARs, the words "shall" and "will" are used in an imperative sense.

2-2. In addition to being mentally and physically fit for an air traffic control tower operator certificate, the applicant must also qualify in which of the following respects?
1. Be able to read, write, and understand the English language, and to speak it clearly and distinctly
2. Be of good moral character
3. Be at least 18 years old
4. All of the above

2-3. All of the following persons may be FAA designated CTO Examiners except
1. Navy tower chiefs
2. FAA tower chiefs
3. FAA chief controllers at joint Navy/FAA facilities
4. FAA regional examiner

2-4. Which of the following persons has the authority to revoke an individual's CTO certificate?
1. The station commanding officer or CNO
2. The ATCF officer
3. The senior Navy qualified controller designated as the CTO examiner
4. The Administrator

● In items 2-5 through 2-7, assume that you were issued an air traffic control operator certificate under FAR 65 on 19 Jan 1975.

2-5. If this certificate were revoked 6 June 1975 and the order of revocation made no provision otherwise, when could you apply for another certificate of the same kind?
1. 6 Sep 1975
2. 1 Jan 1976
3. 6 Dec 1975
4. 6 Jun 1976

2-6. This certificate was issued for what length of time?
1. 1 year
2. 6 months
3. 90 days
4. Until surrendered, suspended, or revoked

2-7. If your CTO certificate were destroyed, you would apply in writing to the FAA Airman Certification Branch, Federal Aviation Administration for a new one. You may carry a telegram from the FAA confirming issuance of your certificate as a certificate pending receipt of a duplicate.

2-8. A temporary CTO certificate with rating is effective for a maximum period of not more than how many days?
1. 30
2. 60
3. 90
4. 120

2-9. The holder of an air traffic control tower operator certificate may NOT perform any duties under that certificate if the controller has served only three of the preceding six months as an operator at the airport to which the facility rating applies.

2-10. What is the minimum amount of time that a control tower operator must satisfactorily serve before being eligible to apply for a facility rating?
1. 6 months
2. 2 months
3. 12 months
4. 4 months

2-11. Which of the following statements indicates that an applicant who failed to make a passing grade on the written test for a control tower operator certificate is ready for reexamination?
1. He applies for retesting in 15 days
2. He receives a written statement that he has received instruction from a certificated and appropriately rated ground instructor in each subject failed and the instructor considers him ready for retesting
3. He receives 10 hours of instruction in each subject area failed
4. He presents a statement within 30 days that he has studied each subject he failed on the test

2-12. Familiarity with which of the following items of information is essential to qualify as a control tower operator?
1. Airman's Information Manual
2. Notices to Airmen
3. Both 1 and 2 above
4. Flight Information Publication System

2-13. At a navy control tower, how many total productive training hours are allotted for an initial CTO rating?
1. 200
2. 280
3. 400
4. 560

2-14. A controller possessing a facility rating for a particular control tower is authorized to issue clearances for IFR flights without prior coordination with the appropriate Air Route Traffic Control Center.

2-15. A person holding a control tower operator certificate, medical certificate, or both, shall present them for inspection upon request by whom?
1. An authorized representative of the National Transportation Safety Board
2. Any federal, state, or local law enforcement officer
3. The administrator
4. Each of the above

2-16. Under normal conditions, a certified air traffic control tower operator must be relieved of all duties after remaining on duty a maximum of how many consecutive hours?
1. 7
2. 8
3. 10
4. 24

Learning Objective: Recognize the extent of controlled airspace and identify the types and limits of such airspace and associate restrictions pertinent thereto.

2-17. The responsibility for the safe and efficient use of the national airspace of the United States was changed by Congress to what organization?
1. FAA
2. CAA
3. ATC
4. ADC

2-18. In relation to Federal airways, what is significant about the airspace above Hawaii?
1. This area has the lowest upper limit in the Federal airway system
2. The airways over this area begin at 1,200 feet and extend to 18,000 feet
3. There is an airway upper limit in this area, but it is revised and altered semiannually
4. There is no upper limit to the airways above this area

2-19. Victor airways are designed for use at what altitudes?
1. Below 18,000 ft
2. From 18,000 ft to FL 450
3. From FL 450 to FL 600
4. Above FL 600

2-20. Federal low altitude airways are normally how wide?
1. 4 statute miles
2. 4 nautical miles
3. 8 nautical miles
4. 8 statute miles

Refer to figure 2-2 in your textbook. In items 2-21 through 2-23, select from column B the airspace structure defined by each of the boundaries listed in column A.

	A. Boundaries	B. Airspace Structures
2-21.	1,200 ft AGL to FL 180	1. Jet routes
		2. Federal airways
2-22.	FL 180 to FL 450	3. Continental control area
2-23.	FL 180 to FL 600	4. Positive control area

2-24. The airspace structure above FL 450 is designed to permit free selection of routes.

2-25. A control area may include all except which of the following airspaces?
1. A federal airway
2. A control area extension
3. The continental control area
4. An additional control area

● For item 2-26, refer to FAR 71 in Appendix D.

2-26. Which of the following is a description of the area defined in FAR 71.13?
1. An area of controlled airspace upward from 1,200 feet wherein instrument landing procedures are uncontrolled
2. An area at the intersection of more than two airways of less than standard size
3. Any area where airways come together upward from 1,200 feet
4. An area designated a transition area in conjunction with an airway, or segment of an airway, beginning at 1,200 feet above the surface of the earth

2-27. Terminal control areas are designated as such commensurate with which of the following conditions?
1. RADAR available
2. Ratio of takeoffs to landings
3. Volume of traffic and number of passengers carried
4. Number and experience of control tower personnel

Learning Objective: Recognize the types of and restrictions to special use airspace in order to provide assistance to pilots using or requiring transition through these areas.

In items 2-28 through 2-30, select from column B the area of special use airspace that is most closely related to each statement in column A.

	A. Statements	B. Special Use Areas
2-28.	Flights are not restricted in this area, but pilots are advised to avoid it during periods of special use	1. Restricted 2. Prohibited 3. Alert
2-29.	Flights are not restricted in this area, but pilots should be informed that a high volume of pilot training or unusual type of aerial activity is taking place	4. Warning
2-30.	Pilots are not allowed to fly into this area except by special permission	

2-31. The using agency of a restricted area is the FAA facility that may authorize transit through or flight within the restricted area.

2-32. An area within ten miles of an airport in which FSS provides advisory service to arriving and departing aircraft describes which of the following areas?
1. AA
2. AAA
3. ATA
4. MTR

2-33. Which of the following statements about operations within a military operations area is NOT correct?
1. They are established for the purpose of separating certain military training activities from IFR air traffic.
2. Whenever a MOA is in use, nonparticipating IFR traffic must be provided IFR separation
3. The controlling facility may reroute or restrict nonparticipating air traffic
4. Only VFR air traffic may be cleared through an operating MOA

Learning Objective: Recognize regulations governing the operation of aircraft as prescribed by FAR, Part 91 and OPNAVINST 3710.7.

2-34. During transoceanic flight, a Pan American jet aircraft is subject to the specific rules of
1. Annex 2 to the Convention on International Civil Aviation
2. the company or agency responsible for the flight
3. the country in which the aircraft is to land
4. FAR 2

2-35. The final authority for use of a runway for takeoff including an assigned preferential runway where the safe operation of an aircraft is concerned rests with the
1. chief airport traffic controller
2. air traffic controller with a facility rating
3. pilot of the aircraft concerned
4. operations officer

2-36. Before beginning an IFR flight, the pilot in command must determine the fuel requirements for the flight. In addition, what other information must the pilot be familiar with?
1. Alternatives available if the flight cannot be completed
2. Any known traffic delays reported by ATC
3. Weather reports and forecasts
4. All of the above

2-37. In a converging situation, which of the following aircraft has right-of-way priority over all the other types listed?
1. Glider
2. Airship
3. Helicopter
4. Balloon

2-38. If an aircraft on a heading of 045° and a glider on a heading of 220° meet one another at the same altitude, what action should be taken?
1. The aircraft should give way
2. Both must give way to the left
3. Both must give way to the right
4. The glider must descend to pass well clear

2-39. In which of the following situations does the first named aircraft have the right-of-way over the second?
1. An A-7 overtaking an A-4E
2. An F-8C approaching an A-6 head-on
3. An F-8C converging with another F-8C on its right
4. A P-3B being overtaken by an A-4E

● In answering item 2-40, refer to text and FAR 91.65 in Appendix D.

2-40. Relative to formation flying, which of the following is expressly forbidden by Federal Aviation Regulations?
1. An Air Force B-52 conducting air-to-air refueling operations with a KC-135
2. A flight of Navy A-4s
3. Two American Airlines DC-9s carrying paying passengers
4. Six T-28s of the Naval Air Training Command under instruction

2-41. Aircraft maneuvers not necessary for normal flights which involve abnormal speeds and abrupt altitude changes are referred to as
1. interceptor attack training
2. dog fights
3. flat hatting
4. aerobatic flights

2-42. According to Federal Aviation Regulations, which of the following is the minimum level above which acrobatic flight in an aircraft is permitted?
1. 500 ft MSL
2. 500 ft above the surface of the earth
3. 1,500 ft MSL
4. 1,500 ft above the surface of the earth

2-43. A jet aircraft may be flown at a speed of more than 200 knots in an airport traffic area provided
1. approval is obtained from the nearest flight service station
2. the aircraft does not exceed an altitude greater than 3,000 ft
3. the duration of the excess-speed flight will not exceed 5 min
4. the operational limits of the aircraft are such that it cannot be safely flown at a slower speed

2-44. Aircraft position lights are specified as essential and must be lighted under which of the following conditions?
1. On all IFR flights
2. Between sunrise and sunset
3. Between sunset and sunrise
4. All of the above

2-45. If an aircraft is being towed through an area of poor illumination in which other aircraft are moving about, which of the following aircraft lights must be operational?
1. Landing
2. Anticollision
3. Cockpit
4. Position

2-46. An aircraft approaching a congested area must pass a 500-foot television tower that is 1,000 feet to the right of the flight path. What is the minimum altitude that the pilot must maintain over the town?
1. 1,000 ft
2. 1,500 ft
3. 2,000 ft
4. 2,500 ft

2-47. Minimum safe altitude restrictions in the Federal Aviation Regulations generally exempts which of the following types of aircraft?
1. Glider
2. Helicopter
3. Jet engine aircraft
4. Reciprocating engine aircraft

2-48. The minimum safe altitude over other than congested areas is
1. 500 feet above the surface
2. 600 feet above the surface
3. 800 feet above mean sea level
4. 1,000 feet above mean sea level

2-49. In the event of a disaster, who has the responsibility to impose temporary flight restrictions in order to provide a safe environment for relief aircraft?
1. Flight service station
2. FAA Administrator
3. Airport manager
4. Tower chief

2-50. For flight above 17,999 feet MSL, all aircraft altimeters must be set to 29.92 inches.

2-51. In an emergency situation in which an aircraft cruising at 6,000 feet receives priority over other aircraft from ATC to make an emergency descent, to whom and under what conditions must the pilot submit a written report?
1. To the FAA Regional Office concerned within 24 hours
2. To the FAA Regional Office concerned, if requested, within 24 hours
3. To the chief of that ATC facility, if requested, within 48 hours
4. To the chief of that ATC facility within 48 hours

2-52. If an airport has no obstructions in its airport traffic area, what is the minimum altitude AGL that should be maintained by a jet aircraft?
1. 1,000 ft
2. 1,500 ft
3. 2,000 ft
4. 2,500 ft

2-53. If a pilot has requested taxiing instructions for takeoff and the tower has issued a clearance to "taxi to" the runway for his takeoff, which of the following statements indicates the correct compliance with taxi procedures according to FAR 91.87?
1. The pilot taxies across intersecting runways and onto his assigned runway and immediately commences his takeoff
2. The pilot taxies across intersecting runways and turns onto his assigned runway and halts for further instructions from the tower
3. The pilot taxies across intersecting runways and stops at the entrance to his assigned runway for further instructions from the tower
4. The pilot halts at each intersecting runway as he taxies to this assigned runway, requesting further tower clearances at each halt

2-54. Which of the following operations is NOT authorized for Navy aircraft?
1. Simulated flameout
2. Simulated emergency flight
3. Simulated instrument flight
4. Fully feathered engine

2-55. Refer to table 2-2 in your textbook. For VFR flight outside of controlled airspace above 1,200 feet, the minimum horizontal distance from clouds is
1. 100 ft
2. 500 ft
3. 1,000 ft
4. 2,000 ft

2-56. When flight visibility is less than one mile, an aircraft may be operated if
1. it is a helicopter operating outside of controlled airspace at or below 1,200 feet above the surface at a reduced speed
2. it is in a control area and the pilot has a clearance from the tower
3. it is over a sparsely populated area and all minimums of safe altitude rules are observed
4. the pilot has cancelled his IFR clearance and is proceeding VFR

2-57. No aircraft, other than helicopters, may be operated in VFR flight under any circumstances when the visibility is less than how many statute miles?
1. 1
2. 2
3. 3
4. 4

2-58. Within what airspace is special VFR flight authorized?
1. Controlled airspace below 14,500 ft
2. All controlled airspace
3. Control zones
4. Uncontrolled airspace only

2-59. Which of the following requirements must be met prior to authorizing special VFR operations?
1. The aircraft must be able to maintain an altitude which is at least 500 ft below clouds
2. The aircraft must be landing or taking off
3. The ground or flight visibility (as appropriate) must be at least 1 mile
4. All of the above

2-60. The pilot of a C-118 is planning a VFR flight below 18,000 feet from NAS Alameda to NAS North Island. The navigator has computed a magnetic heading of 160 degrees for the flight. At which of the following altitudes should the flight be made?
1. 14,500 ft
2. 15,500 ft
3. 16,000 ft
4. 17,000 ft

2-61. The pilot of an A-4 plans to fly VFR above 18,000 feet on a magnetic heading of 255 degrees between Chicago and Denver. The flight could be made by flying at a flight level of
1. 195
2. 215
3. 225
4. 235

2-62. If a pilot is scheduled to fly an aircraft in controlled airspace under IFR conditions, an IFR flight plan must be filed and proper clearance must be received from air traffic control.

In items 2-63 and 2-64, select from column B the Navy IFR takeoff weather minimum that applies to each pilot instrument rating listed in column A.

	A. Instrument Ratings	B. Takeoff Minimums
2-63.	Special instrument rating	1. Circling minimums
2-64.	Standard instrument rating	2. No minimum
		3. 300 ft and 1 mi
		4. 200 ft and 1 mi

In items 2-65 through 2-67, select the correct response from column B as applicable to the terms listed in column A. (Refer to text and Appendix D, FAR 95)

	A. Terms	B. Response
2-65.	MAA	1. Assures navigational signal reception and obstruction clearance between fixes
2-66.	MEA	
2-67.	MRA	2. The lowest altitude at which an intersection can be determined
		3. Navigational signals are assured only within 25 miles of the VOR station concerned
		4. Adequate reception of navigational aid signals is assured

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2-68. The minimum obstruction clearance altitude (MOCA) assures obstruction clearance between specified fixes, but adequate reception of navigational signals is assured only within
1. 15 miles of the TACAN station concerned
2. 25 miles of the VOR station concerned
3. 50 miles of the TACAN station concerned
4. 75 miles of the VOR station concerned

2-69. Which of the following statements about cruising altitudes in controlled airspace under IFR conditions is correct?

1. They are determined by the course being flown and the true airspeed filed
2. They are assigned by air traffic control
3. They are assigned as either even or odd as predetermined and specified by the administrator and published in flight information publications
4. They are requested from, and assigned by, Flight Service for all aircraft as specified in En Route Air Traffic Control Handbook 7110.9

2-70. The absolute landing minimum(s) for a single-piloted aircraft is/are

1. 200 ft and 1/2 mile
2. 2,400 ft RVR
3. Either 1 or 2 above, whichever is higher
4. 300 ft and 1 mile

2-71. An aircraft on an IFR flight plan operating in VFR weather conditions experiences radio failure, and the pilot is not able to maintain two-way radio communications. What should he do?

1. Proceed under VFR and land as soon as practicable
2. Maintain the last assigned altitude and proceed to the alternate airport
3. Fly in close proximity to the nearest control tower en route, show a landing light, and wait for further clearance via blinker and/or flag hoist
4. Maintain the last assigned cruising altitude, reverse course, and return to the last NAVAID checked en route, starting immediate descent upon reaching the NAVAID

Learning Objective: Describe the rules governing aircraft operation in a defense area (FAR, Part 99).

2-72. If an aircraft is scheduled for a flight in the Alaskan Coastal ADIZ, what type of flight plan must the pilot file prior to the flight?

1. An IFR only
2. A DVFR only
3. A DVFR or IFR
4. Both a DVFR and an IFR

2-73. If an aircraft will penetrate the domestic ADIZ on a flight from Mexico to Texas in an area where NO appropriate reporting points are available and the pilot has computed an estimated penetration time of 1805, the pilot must report this estimated time to an appropriate aeronautical facility by at least what time?

1. 1720
2. 1735
3. 1750
4. 1800

2-74. Which of the following flights is exempted from normal FAR requirements for ADIZ operations?

1. Two F-8s crossing through the ADIZ at its lowest boundary under VFR flight
2. An unscheduled air carrier carrying cargo to a military installation within the ADIZ
3. An A-4 on an approved test hop, which will depart from a base within the ADIZ and remain within 10 nautical miles of the base
4. A scheduled foreign airliner inbound to an international airport

Assignment 3

Meteorological Elements Affecting Aviation

Text: Pages 3-1 through 3-40

Learning Objective: Identify standard sea level pressure and associated atmospheric terms, their characteristics and effects.

3-1. Although the troposphere always has its highest vertical extent at the Equator, it is highest at any given point on the earth during what season?

1. Summer
2. Fall
3. Winter
4. Spring

3-2. The layer of the atmosphere in which most of our weather occurs is the

1. stratosphere
2. troposphere
3. ionosphere
4. exosphere

3-3. A high-pressure area is a region in which the atmospheric pressure is

1. constantly changing, but usually greater than that of adjacent areas
2. greater than 1013.2 mb at sea level
3. greater than that of neighboring regions
4. constantly changing

3-4. Which of the following figures was adopted by the International Civil Aeronautical Organization (ICAO) as the standard sea level pressure for calibrating instruments that measure atmospheric pressure?

1. 1013.2 millibars
2. 14.7 pounds per square inch
3. 59.00 pounds per square inch
4. 29.92 inches of mercury

3-5. When the atmospheric pressure at sea level is 30 inches of mercury, the pressure at 8,000 feet is approximately

1. 20 in.
2. 22 in.
3. 24 in.
4. 26 in.

3-6. If a pilot does NOT reset his altimeter setting after takeoff from an airport located in a high-pressure area and flies into a low-pressure area, how will the altimeter read and in what relative position will the aircraft be?

1. Low and the aircraft will be lower than indicated
2. Low the the aircraft will be higher than indicated
3. High and the aircraft will be lower than indicated
4. High and the aircraft will be higher than indicated

3-7. What is a cyclone?

1. A low-pressure area with winds that circulate in a counterclockwise direction in the Northern Hemisphere
2. A low-pressure area with winds that circulate in a clockwise direction in the Northern Hemisphere
3. A high-pressure area with winds that circulate in a counterclockwise direction in the Northern Hemisphere
4. A high-pressure area with winds that circulate in a clockwise direction in the Northern Hemisphere

3-8. Which of the following factors is/are associated with high-pressure systems to make flying conditions more favorable than in low-pressure systems?

1. Fewer clouds and better daytime visibility
2. Less concentrated turbulent areas
3. Light or calm winds
4. All of the above

3-9. Which of the following statements about a hurricane is INCORRECT?

1. A dead calm may exist in its center
2. It is accompanied by anticyclonic winds as high as 175 knots
3. It is accompanied by much rain and thunderstorm activity
4. The wind changes direction after passage of the eye

3-10. A tornado differs from a hurricane in that a tornado has
1. more violent winds and a much larger diameter
2. more violent winds and a much smaller diameter
3. less violent winds and a much smaller diameter
4. less violent winds and a much larger diameter

3-11. The various types of air masses are determined by the measurement of which of the following factors?
1. Temperature and pressure
2. Humidity and temperature
3. Wind velocity and pressure
4. Humidity and wind velocity

3-12. What has the greatest influence upon the characteristics of an air mass?
1. The amount of humidity it contains
2. The length of time it travels
3. The path over which it travels
4. The source region

3-13. Which of the following characteristics is NOT a requirement for an area to be characterized as a good source region?
1. Low pressure
2. High pressure
3. A uniform surface
4. Uniform temperatures

3-14. Which of the following acronyms indicates maritime air of polar origin passing over a surface warmer than the air?
1. mPw
2. mPk
3. mPA
4. MPE

Learning Objective: Recognize the major cloud genera, characteristics, and levels at which they occur.

In items 3-15 through 3-17, select from column B the genera of clouds associated with each cloud etage listed in column A.

	A. Cloud Etage	B. Genera
3-15.	High	1. Stratoform
3-16.	Middle	2. Cumulus
3-17.	Low	3. Cirroform
		4. Altoform

3-18. Which of the following types of clouds generally troubles pilots the least?
1. Cirrus
2. Nimbostratus
3. Stratus
4. Cumulus

3-19. What kinds of clouds may give the first signs of approaching bad weather?
1. Cirrus
2. Stratus
3. Cumulus
4. Cirrocumulus

3-20. The term "mackerel sky" is associated with what type of cloud?
1. Cirrostratus
2. Cumulonimbus
3. Stratocumulus
4. Cirrocumulus

3-21. Clouds that appear similar to a herd of sheep in the sky are associated with wha cloud genera abbreviation?
1. Ac
2. Ci
3. Cc
4. Sc

3-22. A thick gray or blue-gray smooth overcast appearance shows what type of cloud?
1. Altostratus
2. Altocumulus
3. Cirrocumulus
4. Cumulonimbus

3-23. What type of cloud is always accompanied by precipitation?
1. Altocumulus
2. Cirrostratus
3. Stratocumulus
4. Nimbostratus

3-24. A cloud yielding precipitation only in the form of drizzle is called a/an
1. stratocumulus
2. altostratus
3. stratus
4. nimbostratus

3-25. Which of the following types of clouds belong to a group of clouds with pronounced vertical development?
1. Altostratus
2. Cirrostratus
3. Stratocumulus
4. Cumulonimbus

3-26. A flat or anvil top is a characteristic of what type of cloud?
1. Stratus
2. Cumulus
3. Cumulonimbus
4. Stratocumulus

Learning Objective: Identify types, effects, designations, and characteristics of fronts.

3-27. What is a front?
1. A boundary separating two different air masses
2. The face of an approaching cold air mass
3. The face of an approaching warm air mass

3-28. What occurs when a region that is occupied by warm air is invaded by a cold air mass?
1. The cold air is forced upward
2. The cold air mixes with the warm air
3. The cold air pushes the warm air upward
4. The cold air is driven back by the warm air

3-29. All but which of the following weather characteristics is associated with the passage of a cold front?
1. Decreasing pressure
2. Decreasing humidity
3. Decreasing temperature
4. Shifting of wind direction

3-30. Cumulonimbus and nimbostratus clouds located at and immediately to the rear of a surface front characterize a
1. stationary cold front
2. warm front that is moving slowly
3. cold front that is moving slowly
4. cold front that is moving rapidly

3-31. Squall lines are associated with which of the following types of fronts?
1. A warm front
2. An occluded front
3. A fast-moving cold front
4. A slow-moving cold front

3-32. When a warm front is approaching, what type of cloud formation usually appears first?
1. Cirrus
2. Stratus
3. Cirrostratus
4. Nimbostratus

3-33. An occlusion occurs as a result of a
1. warm front overtaking a cold front
2. cold front overtaking a warm front
3. cold front meeting a stationary front
4. warm front meeting a stationary front

3-34. Which of the following types of fronts usually causes extended periods of poor flying weather?
1. Warm
2. Cold
3. Occluded
4. Stationary

Learning Objective: Recognize the characteristics and effects of water vapor in the air and the meaning of terms pertaining to saturated air.

3-35. Water in the air occurs in which of the following forms?
1. Gas
2. Solid
3. Liquid
4. All of the above

3-36. Most of the weather that interferes with the operation of aircraft is directly associated with
1. pressure
2. wind velocity
3. temperature
4. some form of water

3-37. What determines the quantity of water vapor which can be contained in a saturated volume of the atmosphere?
1. The pressure
2. The temperature
3. The amount of air
4. All of the above

3-38. Relative humidity is defined as the
1. mass of water vapor present per unit volume of space
2. ratio of the mass of water vapor to the mass of dry air
3. ratio of the density of water vapor in the air to the density of the air
4. ratio of water vapor in the air to that required for saturation at a given temperature

3-39. The temperature to which air under constant pressure with a constant water vapor content must be cooled in order to become saturated is called the
1. relative humidity
2. dewpoint
3. fog point
4. humidity point

3-40. Which of the following phenomena is classified as a lithometeor?
1. Fog
2. Haze
3. Snow
4. Rain

Learning Objective: Identify features of fog as they pertain to its composition and formation.

3-41. A cloud on the earth's surface is called fog. Which of the following statements most accurately describes this phenomenon?
1. Fog is composed of visible large water droplets
2. Fog is composed of minute, suspended, visible water droplets or ice particles
3. Fog is composed of visible water droplets and is of uniform density
4. Fog is composed of visible water droplets or ice particles that fall earthward

3-42. The basis for the prediction of fog is provided by the differential between the
1. relative humidity and absolute humidity
2. temperature and absolute humidity
3. dewpoint and relative humidity
4. dewpoint and temperature

3-43. Which of the following changes does NOT increase the likelihood of fog formation?
1. The moisture content of the air decreases and the temperature increases
2. The temperature decreases and the moisture content of the air increases
3. The temperature remains constant and the moisture content of the air increases
4. The moisture content of the air remains constant and the temperature decreases

● In answering items 3-44 through 3-51, assume that the atmospheric conditions are conducive to the formation of fog.

3-44. Which of the following combinations of meteorological conditions is most likely to produce a deep and dense fog?
1. A brisk wind in dust-free air
2. A light wind with dust-laden air
3. Calm air laden with dust particles
4. Calm air relatively free of dust particles

3-45. If there is sufficient humidity, which of the following conditions is most favorable for the formation of radiation fog?
1. A clear sky in daytime
2. A clear sky at night
3. An overcast sky at night
4. An overcast sky in daytime

3-46. What kind of fog is formed when a warm, moist air mass passes over a cooler surface?
1. Steam
2. Upslope
3. Advection
4. Radiation

3-47. Advection fog is considered the most dangerous because of its greater degree of
1. density
2. variability
3. condensation
4. area coverage

3-48. What processes are taking place when upslope fog is forming?
1. Air is rising, expanding, and cooling
2. Air is rising, contracting, and cooling
3. Air is descending, expanding, and cooling
4. Air is descending and being warmed by contraction

3-49. When does steam fog occur?
1. When evaporation from warm water saturates cold air passing over it
2. When air rising up a gradual land rise expands and cools
3. When air is carried over a colder surface
4. When a land surface on clear nights cools by giving off heat

3-50. Warm front fog forms as a result of
1. warm waters offshore coming in contact with an adjacent cold land area
2. rain falling from warm air into cold air
3. precipitation within a warm front
4. the up and down movement of warm air along a cold front

3-51. Which of the following hydrometers is NOT a form of precipitation?
1. Dew
2. Snow
3. Hail
4. Drizzle

Learning Objective: Identify types, causes, and results of airframe icing formed during flight.

3-52. What icing conditions normally are NOT encountered in flight?
1. Rime ice and clear ice
2. Rime ice and carburetor ice
3. Frost and slush
4. Clear ice and glaze ice

3-53. What type of icing results when a film of liquid water freezes on an airframe?
1. Frost
2. Rime ice
3. Clear ice
4. Hoarfrost

3-54. Which of the following statements best describes the formation of rime ice?
1. A sudden drop in temperature to freeze supercooled droplets of water which have partially frozen after they have contacted an airframe
2. The partial melting and refreezing of clear ice on an airframe
3. Supercooled droplets of water striking an airframe and freezing separately
4. The surface of an airframe being subjected to some form of precipitation and a sudden drop in temperature causing the precipitation to freeze into a solid sheet of ice

3-55. What type of airframe icing is caused by a high performance aircraft flying rapidly from a region whose temperature is well below freezing to another region where the temperature is considerably higher and the air is very moist?
1. Frost
2. Rime ice
3. Clear ice
4. Glaze ice

3-56. The four intensities of icing are frost, rime, clear, and glaze.

3-57. Which of the following classifications of icing requires immediate flight diversion?
1. Moderate
2. Extreme
3. Severe
4. Heavy

Learning Objective: Recognize conditions and terms associated with turbulence.

3-58. ACs should be aware of what two types of turbulent conditions?
1. Natural and weather
2. Natural and man-made
3. CAT and man-made
4. Thermal and mechanical

3-59. Air near the surface flowing over an obstruction causes what type of turbulence?
1. Mechanical
2. Thermal
3. Wake
4. Light

3-60. Wind shears, sometime referred to as clear air turbulence (CAT), may occur without any visual warning.

3-61. The greatest strength of wake turbulence occurs when an aircraft is heavy, clean, and slow, and starts when the aircraft rotates upward and ends where the aircraft lands.

3-62. The term "chop" refers to a type of turbulence that causes
1. a rhythmic bumpiness with little altitude change
2. the aircraft to be violently tossed about
3. large, abrupt changes in altitude
4. the aircraft to be out of control

3-63. A pilot has given you a report relating to in-flight turbulence. He has included his altitude, position, time turbulence noted, and intensity of the turbulence. What other information must be obtained from the pilot with reference to the report?
1. Type of aircraft involved
2. Whether VFR or IFR conditions exist in the turbulent area
3. Type of cloud coverage associated with the turbulence
4. Whether he has reported the turbulence to a weather facility

Learning Objective: Recognize how thunderstorms are formed and describe their structures and other characteristics.

3-64. What type of frozen precipitation is associated with thunderstorm activity?
1. Snow
2. Hail
3. Sleet
4. Snow grains

3-65. The National Weather Service recognizes how many classes of intensities of thunderstorms?
1. One
2. Two
3. Four
4. Six

3-66. The formation of a thunderstorm needs a combination of what atmospheric conditions?
1. Stable air of relatively low humidity and some type of lifting action
2. Stable air of relatively high humidity and some type of subsiding action
3. Unstable air of relatively low humidity and some type of subsiding action
4. Unstable air of relatively high humidity and some type of lifting action

3-67. Before air becomes unstable what must happen to it?
1. It must descend to a point where the air around it is warmer
2. It must descend to a point where the air around it is colder
3. It must be lifted to a point where it is warmer than the surrounding air
4. It must be lifted to a point where it is colder than the surrounding air

3-68. The three distinct stages of a thunderstorm in the order of its life cycle are
1. anvil, mature, and convective
2. convective, anvil, and mature
3. cumulus, mature, and dissipating
4. mature, dissipating, and cumulus

3-69. At what stage in the life cycle of a thunderstorm do surface rains begin to fall?
1. Anvil
2. Mature
3. Cumulus
4. Convective

3-70. The downdrafts of a thunderstorm cycle are initiated by the
1. frictional drag of rainfall
2. evaporative cooling of the air
3. adiabatic cooling of the air
4. warming of the upper air by condensation

3-71. Downdrafts are significant in what stages of a thunderstorm?
1. Anvil, dissipating, and cumulus
2. Cumulus and dissipating
3. Cumulus and mature
4. Mature and anvil

3-72. The external visual appearance of a thunderstorm is NO indication of the presence and/or severity of hail and turbulence within the storm.

3-73. The strong surface winds associated with a thunderstorm are caused by the
1. vertical spreading of the updraft currents approaching the cloud's base
2. vertical spreading of the horizontal currents as the cloud approaches
3. horizontal spreading of the updraft currents at the cloud's base
4. horizontal spreading of downdraft currents approaching the earth's surface

3-74. How is density altitude obtained?
1. Temperature and pressure data
2. Sky coverage and transparency
3. Precipitation returns
4. Pilot reports

Assignment 4

Aviation Weather Reports, Forecasts and Advisories

Text: Pages 4-1 through 4-24

Learning Objective: Recognize types, uses, format, coding, and contents of the hourly aviation weather report.

4-1. In order to describe as much weather information in as little space as possible, weather service personnel transmit it to air traffic control personnel in the form of numerals, symbols, and contractions.

4-2. What contraction represents the U.S. Air Force network system used to collect and distribute military observations and pilot reports to military users?
1. PIREP
2. COMEDS
3. CONUS
4. NOTAM

4-3. In what class of observations is the sea level pressure, temperature, and dewpoint omitted?
1. L
2. SP
3. RS
4. SA

4-4. When an aircraft mishap occurs near an airport, what kind of observation is made?
1. SP
2. SA
3. L
4. RS

4-5. Refer to figure 4-1 in your textbook. What is the lowest cloud height indicated on this report?
1. 1,100 ft
2. 1,200 ft
3. 2,700 ft
4. 3,800 ft

In items 4-6 through 4-8, refer to table 4-1 of your textbook. Select from column B the sky cover contraction used to designate each cloud cover condition listed in column A.

	A. Cloud Cover Conditions	B. Contraction
4-6.	Surface layer obscuration	1. BKN
		2. OVC
4-7.	Broken layer aloft	3. X
4-8.	Overcast layer aloft	4. SCT

4-9. Refer to figure 4-1 and table 4-3 in your textbook. What is the meaning of the letter preceding the height of the ceiling layer in figure 4-1?
1. Aircraft
2. Measured
3. Indefinite
4. Rawinsonde balloon or radar

4-10. Which of the following sky-coverage symbols is NOT classified as a ceiling?
1. -X
2. BKN
3. OVC
4. X

4-11. Using summation total, how should the following sky and ceiling information be encoded? Cloud layers at 3,000 (3/10 sky cover), measured 4,000 (3/10 sky cover), and 28,000 (3/10 sky cover).
1. 300 SCT 400 BKN 2800 BKN
2. 30 SCT M40 BKN 280 BKN
3. 300 SCT 400 BKN 2800 OVC
4. 30 SCT M40 BKN 280 OVC

4-12. When visibility is measured in statute miles, how is it reported?
1. The nearest 5 miles beyond 15 miles
2. The nearest whole mile up to 15 miles
3. The exact mile and fraction thereof up to 3 miles
4. Each of the above, whichever is applicable

4-13. During nonuniform weather conditions, the prevailing visibility reflects the greatest visibility attained or surpassed throughout

1. 1/4 of the horizon circle
2. 1/2 of the horizon circle
3. 2/3 of the horizon circle
4. 3/4 of the horizon circle

4-14. Certified tower personnel shall report prevailing visibility when the prevailing visibility at the usual point of observation is 3 miles or less.

4-15. Which of the following groupings accurately combines the weather elements and their reporting symbols?

1. Drizzle - A; hail - H; freezing drizzle - ZA
2. Drizzle - D; hail - A; freezing drizzle - ZD
3. Drizzle - L; hail - A; freezing drizzle - ZL
4. Drizzle - L; hail - E; freezing drizzle - ZL

4-16. How should light rain showers and moderate snow showers be encoded?

1. RW-SW
2. R+S(W)
3. RW+(SW)
4. SW RW-

4-17. How should light snow and moderate freezing rain be encoded?

1. -SZR
2. ZRS-
3. S-ZR
4. ZR+S-

4-18. What obstructions to vision symbols indicate smoke, haze, and blowing spray, respectively?

1. K, H, and BY
2. GF, BY, and KH
3. S, H, and BS
4. SM, HZ, and BS

4-19. In figure 4-1 of your textbook, what obstruction(s) to vision is/are indicated?

1. Fog and blowing sand
2. Dust
3. Blowing spray
4. Smoke, fog, and light drizzle

In items 4-20 through 4-22, select from column B the encoded report figure which is an example of each type of weather information listed in column A.

	A. Types of Weather Information	B. Encoded Report Figures
4-20.	Barometric pressure	1. 82/60
4-21.	Temperature and dewpoint	2. 894 (prefix 9)
		3. 992
4-22.	Wind direction and speed	4. 2815

4-23. What is the meaning of the symbols in the coded remarks section of figure 4-1?

1. Base of the reported broken layer is 270 feet
2. Top of the reported broken layer is 270 feet
3. Top of the reported broken layer is 2,700 feet
4. Base of the reported broken layer is 2,700 feet

● Items 4-24 and 4-25 refer to the following NAS Atlanta hourly aviation weather report:
NCQ-XM5BKN8OVC1 3/4F/894/72/63/3605/985/F3

4-24. The encoded ceiling is

1. 800 feet overcast
2. partially obscured
3. zero
4. 500 feet broken

4-25. The wind is

1. 098° at 5 knots
2. 103° at 63 knots
3. 180° at 36 knots
4. 360° at 5 knots

Learning Objective: State the proper broadcasting procedures and phraseology used to transmit weather information.

In items 4-26 through 4-28, select from column B the phraseology used in a radio transmission to a pilot that corresponds with each symbol listed in column A.

	A. Symbols	B. Phraseology
4-26.	M	1. OVERCAST
4-27.	OVC	2. INDEFINITE CEILING
4-28.	-X	3. MEASURED CEILING
		4. SKY PARTIALLY OBSCURED

4-29. Unless specifically requested, which of the following data is omitted from a weather broadcast?
1. Obstructions to vision
2. NOTAMs included in the weather report
3. Runway visual range
4. Sea-level pressure

4-30. How are wind direction and speed encoded as 3241 reported?
1. *WIND FROM THREE TWO ZERO AT FOUR ONE*
2. WIND DIRECTION THREE TWO SPEED FOUR ONE
3. WIND THREE TWO ZERO AT FOUR ONE
4. WIND THREE TWENTY AT FORTY ONE KNOTS

4-31. How is an altimeter setting encoded 983, reported?
1. SETTING TWO NINE EIGHT THREE
2. SETTING TWO NINER EIGHTY THREE
3. ALTIMETER THREE NINE EIGHT THREE
4. ALTIMETER TWO NINER EIGHT THREE

4-32. The abbreviation RVRNO in a report means that the runway visual range is
1. zero
2. variable
3. not available
4. obscured by rain

Learning Objective: Recognize the procedures for recording and transmitting PIREPs to pilots and the weather service.

4-33. A PIREP is usually the only source of information available on which of the following items?
1. Turbulence and wind only
2. Turbulence and icing only
3. Icing and cloud tops only
4. Turbulence, wind, icing, and cloud tops

4-34. ACs are required to solicit PIREPs when which of the following conditions exist or is forecast?
1. Visibility (surface or aloft) at or less than 5 miles
2. CAT of light degree or greater
3. Wind of 30 knots or greater
4. All of the above

4-35. Which of the following pilot reports is NOT classified as a severe PIREP?
1. Tunnel cloud
2. Tornado
3. Moderate clear icing
4. Wind shear

4-36. Which of the following contractions is NOT classified as a TEI?
1. FL
2. OV
3. TP
4. WV

● Items 4-37 through 4-39 refer to the following PIREPs:

UA/OV JAX 135006 0000 FL 070/TP C131/SK 045 OVC UNK
UUA/OV RAN 360035 2314 FL UNK/TP UNK/RM TORNADO MOVG NE INTMT CTC W GND
UA/OV ORF 1096 FL 100/TP DC3/TB LGT
UA/OV RIC 020035 2106 FL 210/TP F18/WV 070050

4-37. Turbulence was experienced by one of the pilots flying at an altitude of
1. 1,000 ft
2. 1,900 ft
3. 6,000 ft
4. 10,000 ft

4-38. The highest wind speed reported by any of the pilots was
1. 50 kt
2. 70 kt
3. 100 kt
4. 106 kt

4-39. The location of the aircraft which relayed a severe PIREP was
1. over ORF
2. 20 miles northeast of RIC
3. 35 miles north of RAN
4. over JAX

Learning Objective: Recognize the types of forecasts and weather advisories, data transmitted, and symbols used.

4-40. The last FT terminal forecast for your area was issued at 1200. Unless amended, the forecast period is inclusive from 1200 on the date of issue until
1. 1800 the same date
2. 0000 the following date
3. 0600 the following date
4. 1200 the following date

4-41. The contractions LIFR, VFR, and IFR when used in FTs and FAs represent
1. a categorical outlook
2. a specific forecast of flight conditions
3. a general forecast of flight conditions for the next 24 hours
4. instrument meteorological conditions

4-42. All FTs and FAs start with a SYNOPSIS, which is a brief summary describing the locations and movements of significant fronts, pressure systems, and circulation patterns.

4-43. SIGMETs are prepared by WSFO offices for their respective districts and contain significant weather information affecting flight safety of transport and other types of aircraft. However, a SIGMET will NOT be issued for which of the following weather developments?
1. Severe icing
2. Squall lines
3. Winds of 40 knots or more at 2,000 feet and below
4. Large area dust storms that lower visibility to less than 3 miles

4-44. The pilot of a single-engine aircraft who plans to fly through a mountain pass is advised of potentially hazardous weather conditions for the specific area by which of the following weather advisories?
1. WH
2. WW
3. SIGMET
4. AIRMET

In items 4-45 through 4-47, select from column the form in which each type of weather advisory listed in column A is transmitted.

	A. Types of Weather Advisories	B. Forms
4-45.	An NOC advisory concerning the location of the storm center, anticipated movement, intensity, and area expected to be affected by a hurricane	1. WW
		2. SEVERE WEATHER OUTLOOK NARRATIVE
4-46.	A severe weather forecast issued by NSSFC	3. SIGMET or AIRMET
4-47.	An NSSFC report of present surface and upper air criteria conducive to generating severe local storms	4. WH

Military Aircraft Performance and Characteristics

Text: 5-1 through 5-15

Learning Objective: Identify military aircraft designations.

● In answering items 4-48 through 4-54, refer to table 5-1 in your textbook.

4-48. Aircraft procured in limited quantities to develop the potentialities of the design are given what prefix letter?
1. Z
2. Y
3. N
4. J

4-49. Aircraft in the research stage of development are given what basic or modified mission symbol?
1. J
2. N
3. X
4. Z

4-50. All but which of the following letters is a modified mission symbol for military aircraft?
1. H
2. R
3. P
4. W

4-51. The letter E in an aircraft designation indicates what modified mission?
1. Attack
2. Observation
3. Antisubmarine
4. Airborne early warning

4-52. Aircraft designed for in-flight refueling of other aircraft are identified by what modified mission symbol?
1. R
2. K
3. B
4. A

4-53. Cargo/transport aircraft have a modified mission symbol of
1. A
2. C
3. P
4. T

4-54. Which of the following designators identifies an aircraft used for training pilots?
1. DT-28B
2. T-39D
3. UH-43C
4. YEA-3A

In items 4-55 through 4-57, refer to the military aircraft designation RA-5C. Select from column B the meaning of each symbol listed in column A.

	A. Symbols	B. Meaning
4-55.	R	1. Basic and/or modified mission symbol
4-56.	A	2. Series symbol
4-57.	5	3. Modified mission symbol
		4. Design designation

4-58. What letter in the military aircraft designation YSH-34J indicates the type of aircraft?
1. H
2. J
3. S
4. Y

4-59. What does the aircraft designation YLB-8B indicate?
1. An experimental fighter modified with special electronic equipment in its first series of basic design
2. A prototype cold-weather bomber in its first series change of the basic design
3. An experimental reconnaissance fighter in its first series of the basic design
4. A permanently grounded attack fighter used for instructional purposes in its eighth series of basic design

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Learning Objective: Recognize pilot and control tower operator responsibilities and aircraft performance and maneuverability characteristics.

4-60. Even though the control tower operator issues a clearance permitting a pilot to make a landing, the pilot is NOT relieved of the responsibility for handling his aircraft cautiously.

4-61. What is/are the reason(s) for jet aircraft being equipped with drogue chutes and afterburners?
1. To allow them to utilize present-day runways
2. To allow them to take off and land crosswind
3. To allow them to take off and land with the wind
4. All of the above

4-62. What effect does a higher field elevation have on aircraft performance?
1. Lowers the rate of climb and lengthens the takeoff distance
2. Lowers the rate of climb and shortens the takeoff distance
3. Increases the rate of climb and lengthens the takeoff distance
4. Increases the rate of climb and shortens the takeoff distance

4-63. As the density of the air increases, how is the lift affected?
1. Decreases
2. Increases
3. Remains the same
4. Decreases momentarily and then increases

4-64. ACs are vitally concerned with the wake turbulence created by both jet and reciprocating-engine aircraft because such turbulence can remain in the approach and landing area for several minutes and endanger other aircraft landing or taking off.

4-65. Wake turbulence is directly related to the weight, wing span, and speed of the aircraft.

4-66. Which of the following statements about wing tip vortices is NOT correct?
1. Vortices are generated from the moment the aircraft leaves the ground
2. Vortices from large aircraft sink until leveling off at a distance of about 900 feet below the aircraft
3. Vortices tend to move laterally over ground at a speed of about 5 knots
4. Vortices are associated with ground operations, such as taxing and warmup operations

---

Learning Objective: Recognize aircraft operational characteristics.

4-67. An AC who has received a request for landing instructions must consider aircraft performance as related to which of the following factors?
1. The aircraft landing speed and the approach pattern
2. The runway length and the barometric pressure
3. The position of all other aircraft under his cognizance
4. All of the above

4-68. The normal range of rate of climb for conventional aircraft is how many feet per minute?
1. 3000 to 5000
2. 1000 to 6000
3. 800 to 4000
4. 500 to 2000

4-69. The report "minimum fuel" indicates that the aircraft's fuel supply has reached a state where upon the pilot is declaring an emergency.

4-70. The configuration of the A-4's landing gear presents a problem of stability when the aircraft lands or takes off under crosswind conditions.

In items 4-71 through 4-73, select from column B the type of aircraft most closely identified by each statement in column A.

	A. Statements	B. Aircraft
4-71.	A two-engine jet aircraft capable of taking off in about 5,000 ft and landing in about 3,000 ft	1. P-3 2. C-130 3. F-4
4-72.	A four-engine turboprop aircraft with a climb rate of 1,500 fpm, a cruise speed of 350 kt, and a capability of operating on two engines for about 17 hr	4. F-8
4-73.	A four-engine turboprop aircraft capable of taking off in about 3,500 ft and landing in about 2,200 ft	

Assignment 5

Air Navigation and Aids to Air Navigation

Text: Pages 6-1 through 6-21

Learning Objective: Recognize the basic fundamentals and terminology of air navigation, the problems encountered, and how to arrive at their solutions.

5-1. Air navigation allows you to perform which of the following functions?
1. To measure the distance of an intended flight and to estimate the time needed to make it
2. To locate positions along an intended flight and at its termination
3. To determine the direction necessary to accomplish an intended flight
4. All of the above

In items 5-2 through 5-4, select from column B the definition of each navigational term listed in column A.

	A. Terms		B. Definitions
5-2.	Position	1.	Some place that can be identified
5-3.	Direction	2.	The spatial separation between two points
5-4.	Distance	3.	The position of one point in space relative to another without reference to distance between them
		4.	An elapsed interval

5-5. What is the primary instrument used in air navigation?
1. A globe of the earth
2. A chart of the earth's surface
3. A set of dividers
4. A navigational plotter

5-6. A position on the earth's surface in relation to a city is useful in identifying the position of an aircraft while it crosses the Atlantic Ocean.

5-7. In aerial navigation, position is expressed in terms of coordinates that are intersections of imaginary lines on the surface of the earth.

5-8. Which of the following statements about a great circle on the earth's surface is INCORRECT?
1. It always passes through both poles
2. It divides the earth into equal halves
3. Its plane passes through the earth's center
4. It may be drawn through any point on the earth's surface

5-9. Which of the following statements about the Equator is/are correct?
1. Its plane divides the earth into the Northern and Southern Hemispheres
2. Every point on it is 90° from both North and South Poles
3. Its plane is perpendicular to the earth's axis
4. All of the above

5-10. A small circle whose plane is parallel to the plane of the Equator is called a
1. parallel of latitude
2. degree of latitude
3. meridian of longitude
4. degree of longitude

5-11. Parallels are imaginary lines that run east and west to measure distance north and south from the Equator.

5-12. The origin for the measurement of longitude on the earth's surface is the
1. Equator
2. 45th parallel
3. Greenwich meridian
4. earth's axis

5-13. What imaginary line is directly opposite the Greenwich meridian?
1. Equator
2. 180° meridian
3. Prime meridian
4. Great circle

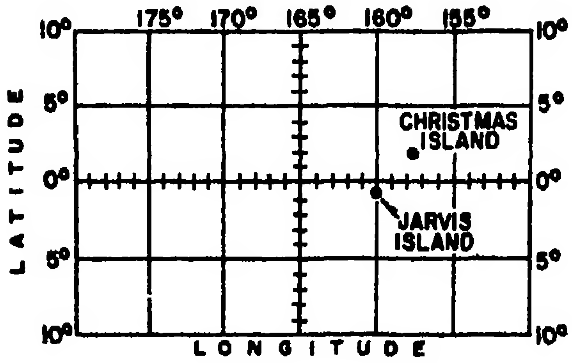

Figure 5A.--Portion of a chart.

● Refer to figure 5A in answering items 5-14 through 5-16.

5-14. Christmas Island is located at approximately
1. 2°00'N 157°30'E
2. 2°00'N 157°30'W
3. 2°00'S 157°30'E
4. 2°00'S 157°30'W

5-15. The difference of latitude (DL) between Jarvis Island and Christmas Island is about
1. 1°00'
2. 1°30'
3. 2°00'
4. 3°00'

5-16. The difference of longitude (DLo) between Jarvis Island and Christmas Island is
1. 2°30'
2. 3°00'
3. 3°30'
4. 4°00'

5-17. When direction is expressed from one point to another on the earth's surface, what is used as the reference point?
1. Greenwich meridian
2. Equator
3. South Pole
4. North Pole

5-18. An aircraft on a heading of 045° is flying in what direction?
1. East
2. West
3. Northeast
4. Southwest

5-19. The magnetic meridians are lines of force that run between the north and south magnetic poles, as in any magnet, and the affect all magnetic materials.

5-20. The angle between magnetic north and true north is called
1. variation
2. deviation
3. heading
4. course

5-21. Magnetic disturbances within an aircraft cause
1. incorrect indicated airspeeds
2. deviation in the magnetic compass
3. variation in the magnetic compass
4. misalignment of the lubber's line

5-22. Swinging the compass is a phrase used to describe the process whereby the deviatic in a particular compass is determined by comparing it with known magnetic headings

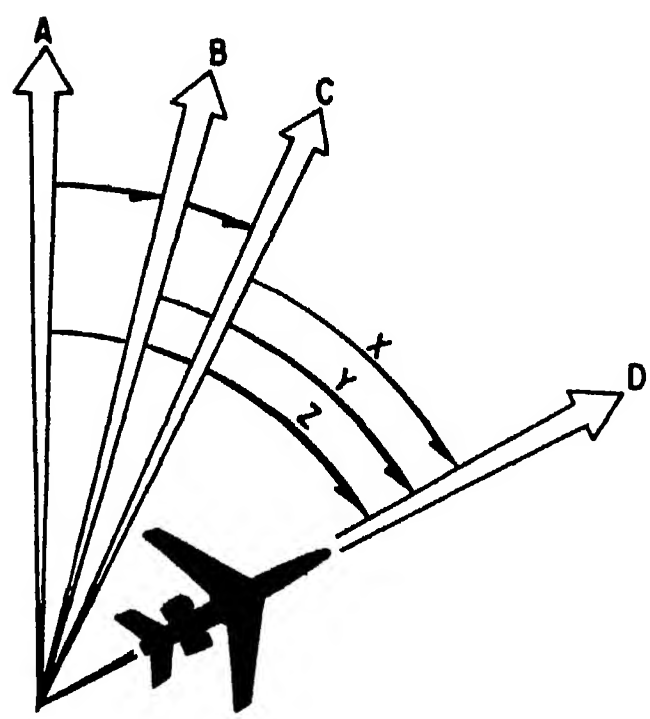

Figure 5B.--North designations in relation to an aircraft in flight.

● Refer to figure 5B in answering items 5-23 and 5-24.

5-23. If the arrow C represents compass north and the deviation and variation are both zero, what arrow represents the direction of true north?
1. A
2. B
3. C
4. D

5-24. If arrow A represents true north, arrow C represents compass north, angle X is 35 , and angle Z is 50 , the total variation and deviation is how many degrees?
1. 15°
2. 35°
3. 40°
4. 50°

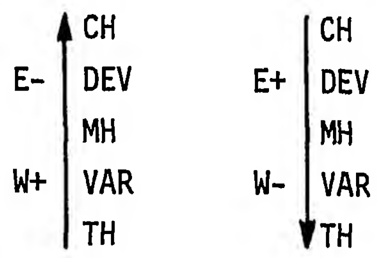

Figure 5C.--Application of Compass Errors.

● Refer to figure 5C in answering items 5-25 and 5-26.

5-25. If an aircraft's true heading is to be 045° when the variation and deviation are 10° east and 3° east respectively, what compass heading must be flown?
1. 032°
2. 035°
3. 038°
4. 042°

5-26. An aircraft's compass reads 060° in an area where the variation is 10° east. If the deviation of the compass is 2° west at a reading of 060°, what is the true heading of the aircraft?
1. 048°
2. 052°
3. 068°
4. 072°

5-27. The distance represented by one nautical mile is equivalent to which of the following values?
1. 2,000 yards for a short distance
2. One minute of latitude
3. 1,852 meters
4. All of the above

5-28. Inasmuch as navigators use nautical miles as the measurement of distance, they use knots as the measurement of speed.

5-29. Five hours after noon is expressed in nautical time as
1. 05:00 p.m.
2. 0500
3. 05:00 a.m.
4. 1700

5-30. When time is determined for other locations on the earth's surface, Greenwich Mean Time (GMT) is used as the standard reference.

5-31. How long does it take the sun to pass through 15° of longitude?
1. 1 hr
2. 52 min
3. 68 min
4. 26 hr

5-32. Greenwich time can also be referred to as
1. zero time
2. Zulu time
3. eastern standard time
4. central standard time

● Refer to figure 6-13 in your textbook in answering items 5-33 through 5-37.

5-33. If your watch is set on eastern standard time, how can you obtain GMT?
1. Add 4 hr
2. Add 5 hr
3. Subtract 4 hr
4. Subtract 5 hr

5-34. To change your watch to local time from GMT upon arrival at an island located at 157°50'W, you should
1. add 10 hr
2. add 11 hr
3. subtract 10 hr
4. subtract 11 hr

5-35. If you are in Tokyo, Japan, where the longitude is 139°45'E and your watch reads 1020 GMT, what is the local Tokyo time?
1. 0020
2. 0120
3. 1920
4. 2020

5-36. When the local time in Bombay (zone -5) is 0700 4 July, what is the local time in Guatemala City (zone +6)?
1. 0800 5 July
2. 1200 4 July
3. 2000 3 July
4. 2000 4 July

5-37. When the local time in Wellington, New Zealand, is 1300M 20 March, what is the local time in Honolulu (zone +11)?
1. 1200X 19 March
2. 1400X 19 March
3. 1200X 20 March
4. 1400X 20 March

5-38. Naval time signals are sent as continuous wave (CW) signals every hour during the period from
1. 00 to 05 minutes after the hour
2. 15 to 30 minutes after the hour
3. 25 to 30 minutes before the hour
4. 05 to 00 minutes before the hour

Learning Objective: Employ the fundamentals of navigational plotting to the extent that you are able to determine a position on the earth's surface.

5-39. An accurate position can be determined if an aircraft's path crosses two intersecting lines of position simultaneously.

5-40. If a pilot sees a small lake lying directly off his right wingtip and notes that his true heading (TH) is 045°, what is the true bearing (TB) of the lake?
1. 045°
2. 135°
3. 225°
4. 315°

5-41. True north is used as the reference direction when measuring which of the following computations?
1. MC and TH
2. MC and TAS
3. TAS and TB
4. TB and TH

5-42. The pilot of an A-6 at an altitude of 10,000 feet on a TH of 270° sights an enemy fighter bearing 220° true. What is the relative bearing (RB) from the bomber to the fighter?
1. 050°
2. 130°
3. 230°
4. 310°

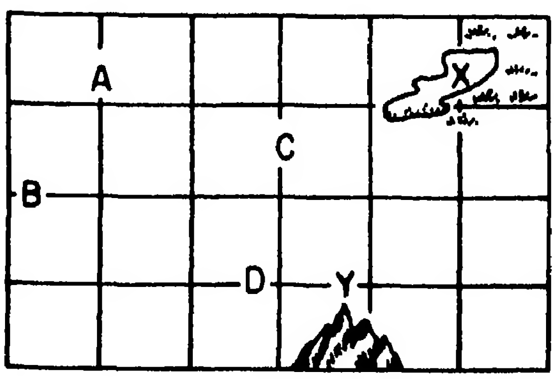

Figure 5D.--Portion of a chart showing landmarks.

- Refer to figure 5D in answering items 5-43 and 5-44.

5-43. If the TH of an aircraft is 045°, the RB to the center of lake (X) is 045°, and the RB to the peak of mountain (Y) is 085°, the aircraft is located at position
1. A
2. B
3. C
4. D

5-44. If the TH of an aircraft is 045°, the RB to the center of lake (X) is 035°, and the RB to the peak of mountain (Y) is 105°, the aircraft is located at position
1. A
2. B
3. C
4. D

5-45. A pilot flying cross-country notes a railroad bridge on his chart at a TB of 050° from his 0900 way point. His TH is 320°, and the way point is directly on the course. His predicted TR has been maintained throughout his flight, and his ETAs at way points have been to the minut If he continues to make his predicted TR and GS, he will see the bridge at 0900 on a RB of about
1. 010°
2. 090°
3. 190°
4. 270°

5-46. Either airborne radar or TACAN can be used by a pilot to determine a fix.

Learning Objective: Recognize information shown on aeronautical charts and chart source, correction, and procurement.

5-47. What type of surface is considered to be undevelopable for chart purposes?
1. Cone
2. Cylinder
3. Plane
4. Sphere

In answering items 5-48 through 5-50, select from column B the desirable chart feature described by each statement in column A.

	A. Statements		B. Features
5-48.	The parallels and meridians intersect at right angles	1.	Correct shape representation
5-49.	The distance of every place from every other place bears a constant ratio to true distance on the earth	2.	Constant and correct scale
5-50.	The chart is conformal, and the scale is constant and correct in all directions	3.	Coordinates easy to locate
		4.	Conformality

5-51. A line that makes the same oblique angle with all meridians is called a
1. track line
2. rhumb line
3. loxodromic curve
4. great circle course line

5-52. Which of the following definitions describes an aeronautical chart?
1. A map used by oceanographers only at sea
2. A pictorial representation of the earth and its culture
3. A blank piece of paper upon which grid lines have been superimposed
4. A blank piece of paper upon which a map showing the entire surface of the earth is superimposed

● Items 5-53 through 5-55 refer to figure 6-16 in your textbook.

5-53. What chart projection has a straight rhumb line?
1. Lambert Conformal
2. Transverse Mercator
3. Mercator
4. Polar Stereographic

5-54. What chart projection shows the least distortion of shapes and areas?
1. Lambert Conformal
2. Transverse Mercator
3. Polar Stereographic
4. Mercator

5-55. What chart projection can be produced graphically?
1. Lambert Conformal
2. Polar Stereographic
3. Transverse Mercator
4. Mercator

5-56. Which of the following areas is likely to be represented by the smallest scale chart?
1. California
2. NAS, Alameda
3. The United States
4. The West Coast of the United States

In answering items 5-57 through 5-59, select from column B the definition of each aeronautical chart term listed in column A.

	A. Terms		B. Definitions
5-57.	Graticule	1.	Lines of latitude and longitude
5-58.	Relief	2.	All features portrayed except those on the aeronautical or grid overprint
5-59.	Contour	3.	A line connecting all points of a given elevation above sea level
		4.	Physical features related to relative differences in land surface elevation

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5-60. What technique of chart-making provides for large, white, open water areas and accentuates small bodies of water and small islands?
1. Water tint
2. Water vignette
3. Land tint
4. Relief

5-61. Density of culture portrayed on a chart is related to which of the following features?
1. Geographic area covered
2. Chart use
3. Chart scale
4. All of the above

Learning Objective: Identify the procedures for requisitioning aeronautical charts and publications, and the uses of and updating procedures for these products.

5-62. Who procures and distributes aeronautical charts and publications used by Navy facilities?
1. The Defense Mapping Agency
2. The Coast and Geodetic Survey
3. The Naval Oceanographic Office
4. The Navy Printing Office

5-63. Which of the following activities receives and processes aeronautical chart requisitions for units within CONUS?
1. DMA Depot, Philadelphia
2. DMA Hydrographic Center, Washington, D.C.
3. DMA Distribution Control Point, Washington, D.C.
4. DMA Aerospace Center, St. Louis

5-64. Which of the following activities receives and processes FLIP requisitions for units within CONUS?
1. DMA Depot, Philadelphia
2. DMA Hydrographic Center, Washington, D.C.
3. DMA Distribution Control Point, Washington, D.C.
4. DMA Aerospace Center, St. Louis

5-65. To which of the following publications should an AC in flight planning refer for information concerning availability and requisitioning of FLIPs from the Defense Mapping Agency distribution system?
1. TATC 7210.3 (Series)
2. TATC 7110.8 (Series)
3. OPNAV 7220.2 (Series)
4. DMA Catalog of Maps, Charts, and Related Products, Part 1, Volume 1

5-66. The flight clearance supervisor should check what publication to determine if there were significant changes or corrections which should be made to an aeronautical chart that he would issue a pilot?
1. CHUM
2. Aeronautical Chart Bulletin
3. Aeronautical Chart Bulletin Digest
4. Catalog of Aeronautical Charts and FLIPs

5-67. To determine if a DOD aeronautical chart is the latest edition, an AC should compare the chart edition number with the edition number listed in the current issue(s) of
1. CHUM
2. Aeronautical Chart Bulletins only
3. Aeronautical Chart Bulletin Digest only
4. Aeronautical Chart Bulletins and Aeronautical Chart Bulletin Digest

5-68. Of the following forms for requisitioning aeronautical charts and publications, the only one that may be sent via the Automatic Digital Network is
1. DD Form 173
2. DD Form 1348
3. DD Form 1348m
4. SF 344

5-69. What requisition form should be used if the stock number of the chart being order is NOT known by the requisitioner?
1. SF 344
2. DD Form 1348
3. DD Form 1348m
4. DD Form 173

5-70. Requests for automatic distribution of DMA aeronautical products should be sent to the
1. DMA Depot
2. DMA Distribution Control Point only
3. DMA Aerospace Center only
4. DMA Distribution Control Point or DMA Aerospace Center as appropriate

5-71. What charts are used in lieu of the domestic World Aeronautical Charts (WAC)?
1. Operational Navigation Charts (ONC)
2. Tactical Pilotage Charts (TPC)
3. Sectional Charts
4. VFR Terminal Area Charts

Assignment 6

Air Navigation and Aids to Air Navigation

Text: Pages 6-22 through 6-55

Learning Objective: Identify the general scope of the flight information program.

6-1. The Flight Information Publication (FLIP) program is concerned with which of the following phases of flight?
1. Operations at naval air stations
2. Planning and terminal only
3. Planning, en route, and terminal
4. En route and weather information only

6-2. FLIP Planning is functionally arranged into two parts: General Planning (GP) and Area Planning (AP).

In items 6-3 through 6-5, select from column B the FLIP Planning section in which the item of information listed in column A is contained.

	A. Items of Information	B. FLIP Planning Sections
6-3.	World-wide conversion tables	1. AP/1A, 2A, and 3A
6-4.	Planning and procedure data for a specific geographical area of the world	2. AP/1, 2, and 3
		3. General Planning
6-5.	Restricted, Prohibited, and Danger areas	4. AP/1B

6-6. Which of the following notices is used to update FLIP Planning?
1. ICN
2. MAN
3. PCN
4. FCCN

6-7. FLIP En Route and Terminal publications are designed to provide information relating primarily to
1. runway surface conditions and lighting
2. radio communications facilities
3. aerodrome layout
4. in-flight IFR operations

6-8. The charts which depict the Federal airway system and the related information for IFR operation at altitudes below 18,000 feet MSL are covered by what sheets of the FLIP En Route Low Altitude--U.S. Charts?
1. L-1 through L-13
2. L-1 through L-26
3. L-13 through L-26
4. L-20 through L-26

6-9. Major changes to the airway structures shown on low- and high-altitude charts are scheduled by the FAA to become effective on a specific date specified in weekly NOTAMs.

6-10. Which of the following procedures or information is contained in the FLIP En Route IFR Supplement--U.S.?
1. The low-altitude instrument approach procedures
2. A cross-reference to IFR aerodromes
3. The sketches of all IFR aerodromes in alphabetical order
4. An alphabetical listing of all IFR aerodromes

6-11. Aeronautical information for use by pilots in flight, but which is not subject to frequent change, is contained in what FLIP publication?
1. Airman Information Manual
2. Flight Information Handbook
3. FLIP Planning (General)
4. FLIP Planning (Area)

6-12. Which of the following FLIP publication(s) is/are published every 8 weeks?
1. Terminal Low-Altitude--U.S.
2. En Route IFR Supplement--U.S.
3. En Route High-Altitude--U.S.
4. All of the above

6-13. Military Aviation Notices (MANs) are issued to update which of the following FLIP publications?
1. U.S. Low-Altitude Terminal
2. U.S. High-Altitude Terminal
3. Both 1 and 2 above
4. *Standard Instrument Departures (SIDs)*

6-14. What information does the Foreign Clearance Guide contain?
1. The transportation of material aboard aircraft
2. The aircraft movements to, from, and between foreign areas
3. The USAF worldwide foreign clearance requirements and information on personal travel
4. All of the above

6-15. How often are Foreign Clearance Guide Change Notices (FCCN) issued?
1. Weekly
2. Monthly
3. Quarterly
4. Semiannually

6-16. The Airman's Information Manual is used as a pilot's operational manual within the United States as a ready reference for ACs assisting pilots and as part of an AC's practical test for a CTO certificate.

6-17. A glossary of aeronautical terms will be found in what part of the AIM?
1. Basic Flight Manual and ATC Procedures
2. Airport Directory
3. Graphic Notices and Supplemental Data
4. Notices to Airmen (NOTAM)

6-18. The Notices to Airmen section of the AIM is issued every
1. 14 days
2. 28 days
3. 90 days
4. 180 days

Learning Objective: Identify basic radio principles and terms.

6-19. Refer to figure 6-25 in your textbook. A cycle may be defined as
1. the distance between corresponding points on consecutive waves
2. the distance from peak to peak on a wave
3. the distance from crest to trough on a wave
4. the distance between two consecutive wavelengths

6-20. What electromagnetic wave is composed of a continuous series of similar waves of like characteristics?
1. MCW
2. Continuous
3. Both 1 and 2 above
4. Broken carrier

6-21. When modulated carrier wave radio transmissions are being used to convey a voice message, the unit in the system which reproduces the original message is the radio receiver.

6-22. What type of modulation usually results in the radio receiver's output being nearly free of static?
1. Phase
2. Pulse
3. Amplitude
4. Frequency

6-23. Single sideband transmission is most desirable when you need NOT be concerned with economy in the use of power needed to transmit.

6-24. A conductor used for radiating electromagnetic energy into space or for collecting it from space is called a/an
1. magnet
2. conductor
3. antenna
4. capacitor

6-25. The property of interchangeability of the same antenna for transmitting and receiving operations is known as antenna reciprocity.

6-26. A radio receiver is a device which selec a single frequency of electromagnetic radiation from an antenna and demodulate' the signal to produce audible or usable frequencies.

Learning Objective: Identify uses, characteristics, operational procedures, and capabilities of omnidirectional range systems.

6-27. In which of the following frequency bands do nondirectional radio beacons operate?
1. 100 to 500 kHz
2. 300 to 1650 kHz
3. Low and medium
4. High and ultra-high

6-28. An NDB classified as an L facility is associated with what type of system?
1. Terminal homing
2. Instrument landing
3. En route radio range
4. Outer fix identifying

6-29. What is the maximum power output of an L facility?
1. 5 watts
2. 10 watts
3. 20 watts
4. 25 watts

6-30. What does the removal of the identification signal from a radio aid indicate to a pilot?
1. The facility is awaiting flight check
2. The facility is unusable
3. The facility is susceptible to intermittent operation and should be used only in VFR conditions
4. The facility may be used for holding purposes only

6-31. What is the classification for an NDB with a power output of less than 50 watts, a range of 25 miles, and no voice feature?
1. WFM
2. MHW
3. NDBMW
4. FMNDBW

6-32. Which of the following classifications identifies a nondirectional beacon that has the highest power output but does NOT make voice transmissions?
1. HH
2. HH W
3. H W
4. MH

● *In items 6-33 and 6-34, assume that an A-4 is on a magnetic heading of 360° and the radio compass needle points to 240°.*

6-33. Where is the automatic direction finding (ADF) station in relation to the aircraft?
1. Behind and to the left
2. Behind and to the right
3. Ahead and to the left
4. Ahead and to the right

6-34. Which of the following turns represents the smallest course alteration (degrees of heading change) so the aircraft will home on the ADF station?
1. Counterclockwise 120°
2. Clockwise 180°
3. Either clockwise or counterclockwise 180°
4. Clockwise 240°

6-35. A major undesirable characteristic of an NDB is
1. the beacon's radio signal is subject to fading and static during stormy weather
2. only a limited number of aircraft can receive the radio signal
3. the beacon's radio signal is subject to line of sight distortion
4. the radio compass which indicates the relative bearing of the station from the nose of the aircraft

6-36. How many usable courses are produced by an ominfacility?
1. 36
2. 360
3. 720
4. Infinite number

6-37. An aircraft is on which radial when flying inbound on a magnetic heading of 180° to an omnidirectional facility?
1. 090°
2. 180°
3. 270°
4. 360°

6-38. Between what frequencies do VORs operate?
1. 80.0 and 90.0 MHz
2. 98.0 and 108.0 MHz
3. 108.0 and 118.0 MHz
4. 118.0 and 128.0 MHz

6-39. The comparison between the change in the azimuth of the variable phase to that of the reference phase is the basic principle of the omnidirectional facility.

6-40. The omnirange transmission consists of one reference signal and a rotating signal that are out of phase on all points of the compass EXCEPT which of the following directions?
1. 045°, 135°, 225°, and 315°
2. 000°, 090°, and 270°
3. 000° and 180°
4. Magnetic north

6-41. An advantage of VOR navigation over NDB navigation is that VOR navigation
1. provides pilots with straight course guidance presentations
2. provides pilots a positive means of identifying facilities
3. reduces flight distances between departure and destinations stations
4. eliminates all requirements for pilots to cross-check their position with another facility

6-42. The omnirange systems are usually reliable regardless of atmospheric conditions because they
1. have LVOR "gap fillers"
2. operate in the VHF/UHF range
3. are not limited to four courses
4. operate at much higher power than other radio aids

6-43. An advantage of distance measuring equipment (DME) is that both bearing and distance are provided from a selected NAVAID facility.

6-44. What are the two basic systems necessary for a pilot to receive distance information?
1. A ground interrogator and an airborne transponder
2. A ground transponder and an airborne interrogator
3. A ground computer and airborne slant range duplexer
4. A ground slant range duplexer and an airborne computer

6-45. What does the VOR/DME facility provide?
1. Bearing only from the facility
2. Bearing and elevation from the facility
3. Elevation only from the facility
4. Distance and direction from the facility

6-46. DME has aided navigation and control practices and procedures considerably. One such procedure DME has affected is
1. the reduction in separation standards between aircraft using DME
2. that en route courses lead straight to and from a NAVAID facility equipped with DME
3. the high altitude penetration by reducing the need for following of DME equipped aircraft
4. that aircraft using DME require less flying time between stations and therefore ease the traffic congestion problem

6-47. VOR, TACAN, and VORTAC NAVAIDs are classe as terminal, low-altitude, and high-altitude.

6-48. A TACAN facility classified as a "T" facility may be approved for use at whicl of the following altitudes?
1. From 18,000 ft to FL 450
2. Above FL 450
3. From 14,500 to 17,999 ft
4. 12,000 ft and below

6-49. The interval between transmissions of a 3-letter Morse code identifier by a TACAI facility is
1. 10.5 sec
2. 15.5 sec
3. 25.5 sec
4. 37.5 sec

6-50. FAR 92 provides radials at certified airborne checkpoints in the airport vicinity to ensure that the accuracy of VOR receivers in the aircraft is within a tolerance of plus or minus 6 degrees for IFR flights.

6-51. What checkpoint on the airport is used b a pilot to check VOR/TACAN prior to fligh
1. Any position on the taxiway
2. Any position on the runway
3. Both 1 and 2 above
4. A position on the taxiway indicated by a yellow triangle

6-52. A ground TACAN facility is capable of simultaneously providing
1. bearing and distance information to an unlimited number of aircraft
2. distance information to an unlimited number of aircraft and bearing information to as many as 120 aircra
3. bearing information to an unlimited number of aircraft and distance info mation to as many as 126 aircraft
4. bearing information to an unlimited number of aircraft when within range and distance information to as many as 120 aircraft

6-53. In order for two pilots to utilize air-t air ranging, they must agree to use two TACAN channels that are separated by
1. 25 MHz
2. 50 MHz
3. 63 MHz
4. 75 MHz

6-54. An aircraft must be equipped with which of the following instruments to utilize TACAN fully?
1. Radio magnetic indicator and range indicator
2. Ambiguity indicator and range indicator
3. Course indicator, ambiguity indicator, and radio magnetic indicator (RMI)
4. Range indicator, course indicator, and radio magnetic indicator (RMI)

6-55. Refer to figure 6-36 in your textbook. Assume that the course indicator reads FROM instead of TO and flight conditions have NOT changed. What bearing will the number 2 needle on the RMI indicate?
1. 060°
2. 150°
3. 240°
4. 330°

6-56. Refer to figures 6-36 and 6-37 in your textbook. What indication is given by the course indicator used with TACAN equipment when a pilot is flying on the selected course toward an omnirange station?
1. The OFF flag appears
2. A small panel light is illuminated
3. The word FROM appears in a small window
4. The indicator bar centers

6-57. When an aircraft passes through a large cone of ambiguity located directly over a TACAN station, which of the following information will be indicated on the aircraft's instrument panel?
1. The radio compass indicator will rotate aimlessly and stabilize at 180° from the bearing approaching the station
2. The range indicator will indicate distance above the station
3. The vertical bar on the course indicator will fluctuate from side to side momentarily, and the TO-FROM indicator will indicate FROM
4. All of the above

6-58. An ATC clearance is issued to a pilot requiring ARC of a TACAN facility. To maintain the ARC, a magnetic reading should be selected from which of the following instruments?
1. Range indicator
2. RMI
3. Course indicator
4. TO-FROM indicator

Learning Objective: Recognize the capabilities, limitations, and operation of the Instrument Landing System (ILS).

6-59. Which of the following transmitters or NAVAIDs is NOT a basic component of an ILS system?
1. Marker beacon
2. Direction finder
3. Localizer transmitter
4. Glide slope transmitter

6-60. Which of the following navigational or visual aids is NOT a supplementary component in an ILS system?
1. DME
2. VOR
3. Compass locator
4. High-intensity approach light

6-61. An aircraft is on an ILS approach 18 nautical miles from the runway. What is the minimum altitude for receiving the oncourse signal from the localizer?
1. 1,000 ft
2. 3,000 ft
3. 4,000 ft
4. 4,500 ft

6-62. The frequency selector in an ILS system automatically switches the glidepath receiver to the appropriate frequency when the pilot selects which of the following frequencies?
1. The proper guidepath frequency
2. The proper fanmarker frequency
3. Either 1 or 2 above
4. The proper localizer frequency

6-63. The middle marker of an ILS course is indicated on the ILS marker receiver in the aircraft by
1. white light flashing dots and dashes
2. amber light flashing dots
3. purple light flashing dots
4. amber light flashing dots and dashes

Learning Objective: Distinguish the minimum standards required for monitoring NAVAIDs.

6-64. To authorize local monitoring of a NAVAID, which of the following requirements must be met?
1. A person familiar with the monitor indications is continuously at the site
2. Remote monitoring capability for each NAVAID is installed at the site
3. The person at the NAVAID site is qualified to release a NOTAM in the event of a NAVAID malfunction
4. A backup transmitter for the NAVAID is available

6-65. To designate the responsibility for monitoring NAVAID to another facility, which of the following requirements must be met?
1. The other facility is continuously manned
2. Remote monitoring capability for each NAVAID is installed in the other facility
3. Procedures for reporting outages are contained in a local operating procedure notice
4. All of the above

6-66. When both aural and visual NAVAID monitor alarms are inoperative, NAVAIDs must be checked at least
1. at the beginning of each watch
2. every 30 minutes
3. hourly
4. every 2 hours

6-67. The priority of assignment of the NAVAID monitor authority is first the control tower, then the fixed approach control.

Learning Objective: Recognize terminologies related to RNAV.

6-68. RNAV eliminates the requirement for the pilot to fly directly to or from a groun station.

6-69. Area Navigation (RNAV) utilizes signals received from
1. compass locators
2. ILS
3. LFMH
4. VORTAC

6-70. If you obtain an ATC clearance from the local ARTCC which specifies a routing such as J EIGHTY-FIVE ROMEO, it means th
1. this is an RNAV route
2. it is a practice clearance for controller training purposes only
3. a suspected error was made in the routing assignment and the pilot is expected to verify the assigned rout is correct
4. this clearance is a modification of the original clearance

6-71. Each RNAV route segment is composed of h many subsequent waypoints?
1. Six
2. Two
3. Three
4. Four

Assignment 7

Flight Assistance Services

Text: Pages 7-1 through 7-33

Learning Objective: Recognize pilot responsibility and the assistance an AC provides to the pilot in planning a flight.

7-1. Records indicate that ACs assigned to the planning phase of aircraft clearances can help avert accidents and incidents involving aircraft by critically inspecting all flight plans and taking proper action when incompletenesses or discrepancies are detected.

7-2. What is the purpose of the flight planning section?
1. It provides pilots with a centralized collection of aeronautical information necessary for preparing flight plans
2. It correlates weather and clearance authorization data
3. It provides a comfortable and convenient location for the preparation of flight plans
4. It provides pilots with navigational equipment needed for planning flights

7-3. The purpose of a flight packet is to provide the pilot with
1. a flight lunch
2. tools necessary to complete the flight
3. a filled-in flight plan
4. a filled-in weather brief sheet

7-4. All except which of the following factors will cause the contents of flight packets for station aircraft to vary?
1. The mission of the flight
2. The type of aircraft used
3. The number of aircraft used
4. The geographical location of the station

7-5. Aircraft squadrons VC 21 and VA 1, having 12 and 15 aircraft, respectively, are based at a naval air station which has 5 station aircraft. How many flight packets must be maintained in the NAS Flight Planning/Approval Branch?
1. 33
2. 15
3. 12
4. 5

7-6. Flight packet checklists are used as
1. selection lists of items deemed necessary for the flight only
2. custody receipts for valuable materials that belong to the government only
3. safeguards to prevent omission of items that may be essential to the flight only
4. a checklist to serve all these requirements

7-7. As an AC3 assigned to the air traffic control division of a naval air station, you could be responsible for maintaining flight data and status boards that display which of the following information?
1. Inbound flights
2. The status of the station's navigational aids
3. The status of aircraft and crew assigned to search and rescue (SAR) duty
4. All of the above

7-8. Although the primary responsibility for preflight planning rests with the pilot in command, this responsibility is shared by the
1. flight line crew
2. officer in charge
3. Air Traffic Controller
4. duty forecaster

7-9. A pilot planning a flight is NOT required to perform which of the following functions?
1. Familiarize himself with available weather reports and forecasts
2. Determine fuel requirements
3. Determine available alternatives and known traffic delays
4. Submit his flight plan to an ARTCC facility

7-10. The DD 175 Military Flight Plan must be used for all flights within the North American (NAM) Region which includes
1. the continent of North America
2. the Continental United States only
3. the 50 states and Canada to the North Pole
4. Canada to the North Pole and the Continental United States

7-11. Pilots are responsible for reviewing and being familiar with weather conditions for the area in which their flight is contemplated.

7-12. After a pilot receives a weather briefing for a flight under instrument flight conditions, the DD Form 175-1 must be completed by the
1. pilot only
2. weather service forecaster only
3. both the pilot and forecaster
4. operations duty officer

7-13. Relative to the information the pilot receives on the DD Form 175-1, the AC should assist him to ensure that the
1. weather briefing is filed
2. weather briefing is still valid at takeoff
3. weather information is accurate
4. operations duty officer sees the weather information report

7-14. If the daily flight schedule is used for clearing an aircraft for a local flight, the completed flight schedule must be retained in the base operations files for
1. 7 days
2. 30 days
3. 60 days
4. 90 days

7-15. Copies of the flight plan and weather forms for a completed flight must be kept on file at the point of
1. departure only
2. landing only
3. departure and point of landing
4. departure or point of landing, but not both

7-16. When a Navy aircraft files a flight plan at a civilian airport, the FAA will hold the flight plan for how many days before forwarding it to the home station of the aircraft?
1. 14
2. 15
3. 28
4. 30

Learning Objective: Recognize pilot limitations of flights involving en route stops and ship/shore operations, the functions of flight service stations, and means and techniques of relaying flight data.

7-17. A single DD Form 175 may be used for a flight which involves en route stops within the United States if a different pilot in command is used for each leg of the flight.

7-18. ACs are normally concerned with aircraft weight and balance on stopover flights.

7-19. What should be done relative to the flight plan of a VFR flight departing a carrier if communications between the ship and the shore activity specified in the flight plan as the destination airport CANNOT be established?
1. The departure controller should caus the flight plan to be sent via regular naval communications
2. The pilot should file his flight pla by radio with the nearest shore acti ity as soon as possible after takeof
3. The pilot should land at the nearest shore activity and file the flight plan to destination
4. The departure controllers should notify the pilot of the aircraft en route as soon as the flight plan is acknowledged by an alternate airport

7-20. V70 appears on the VIP/passenger/cargo section of a flight notification message The meaning of this code is
1. the aircraft will remain overnight, depart at 0700, and can accept no passengers
2. a Navy vice admiral is on board who requests no honors, but requests an informal visit with the commanding officer
3. a Navy captain is on board who requests nothing
4. the aircraft will remain overnight and has a Navy captain on board who requests no quarters

7-21. The functions of the Flight Service Stations (FSS) include which of the following?
1. Accepting and closing flight plans and disseminating notices to airmen (NOTAMs)
2. Assisting lost VFR aircraft and assisting in the search for missing VFR aircraft
3. Maintaining en route communications with VFR aircraft and operating the national teletypewriter systems
4. All of the above

7-22. Communications dealing with flight plans and related messages concerning the movement of aircraft from a naval air station to an aircraft carrier are transmitted via
1. telephone
2. local interphone
3. Area B network
4. *Navy communications*

7-23. What teletype circuit is used to relay communications concerning IFR aircraft movement and control messages from one ARTCC to another?
1. Area B
2. Center B
3. Service F
4. Military B

7-24. Utility B is a teletype circuit which connects military base operations with ARTCCs for the purpose of transmitting proposed IFR flight plans.

Learning Objective: Identify data to be posted on flight progress strips and abbreviations, contractions, and symbols used for posting the data.

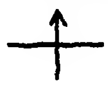
7-25. Current data on air traffic clearances required for air traffic control and air traffic service are posted on
1. flight plans
2. DD Forms 175
3. flight progress strips
4. daily flight schedules

7-26. Flight data can be recorded on flight progress strips in plain language, the abbreviations or contractions contained in FAA Hnadbook 7110.65.

In items 7-27 through 7-29, select from column B the branch, mission, or meaning designated by each prefix or suffix listed in column A and used in box 1 or box 3 of flight progress strips.

	A. Prefixes/ Suffixes	B. Branches/Meanings/ Missions
7-27.	VV	1. U.S. Navy
7-28.	M	2. DME, transponder with no altitude encoding capability
7-29.	/B	3. Military Airlift Command
		4. TACAN only

Refer to figure 7-7 in your textbook. Select from column B the meaning of each control information symbol listed in column A and used in various boxes of both departure and arrival flight progress strips.

	A. Symbols	B. Meanings
7-30.		1. Cruise
		2. Takeoff
7-31.	>	3. At or above
7-32.	→	4. Before

7-33. What abbreviation is used on flight progress strips to indicate that an aircraft is cleared for landing and takeoff through an intermediate point?
1. D
2. H
3. T
4. Z

In items 7-34 through 7-36, select from column B the abbreviation that may be used on flight progress strips by approach control or control tower operators to convey each meaning listed in column A.

	A. Meanings	B. Abbreviations
7-34.	Report crossing	1. CA
7-35.	VFR conditions on top	2. RX
		3. OTP
7-36.	Straight-in approach	4. SI

Learning Objective: Recognize means and procedures for transmitting information pertaining to both VFR and IFR flights.

7-37. When flight service receives the required information for a VFR flight, the information is then transmitted to the aircraft's destination by
1. Area B teletype
2. Center B teletype
3. flight service interphone
4. Service F interphone

7-38. Upon receipt of a flight movement message, base operations is required to forward this information to flight service within how many minutes?
1. 5
2. 10
3. 20
4. 30

7-39. If the destination FSS fails to acknowledge a flight notification message from the departure FSS relative to a flight whose ETE is 2 1/2 hours after takeoff, when must the departure FSS use a regular telephone to assure delivery of the message to the destination FSS?
1. 30 minutes after departure
2. 1 hour after departure
3. 1 hour before the ETA
4. Any time before the ETA

7-40. When a flight departs after the first of three scheduled intermediate stops en route to its destination airport, the FSS serving that stop will transmit
1. the departure time to the next intermediate stopover point
2. the departure time to the remaining stopover points
3. an ETA for the next intermediate stopover point
4. an ETA for the reminaing stopover points

7-41. An aircraft arrives at your station prior to your receiving a flight notification message. To whom must the arrival be reported?
1. The departure FSS tie-in
2. The destination FSS tie-in
3. The departure airport
4. All of the above

7-42. Which of the following items is NOT recorded on a DD 175 but is required wher an IFR flight plan message is transmittec on a utility B teletype circuit?
1. The true airspeed
2. The aircraft identification
3. The departure point
4. The letters FP

7-43. Information relative to an IFR flight such as departure, progress, and arrival reports must be relayed to the appropriat ATC facility on a/an
1. Area B circuit
2. Center B circuit
3. Utility B circuit
4. Service F circuit

7-44. If a pilot files a flight plan which includes a change from VFR to IFR en route to a destination, the proposed IFR flight plan message is relayed to the ARTCC in whose area the flight changes from VFR to IFR.

7-45. Notifying the pilot that GCA is inoperative could properly be the subject of a flight advisory to an inbound aircraft.

7-46. A flight advisory to a Navy aircraft describing adverse weather conditions existing at a destination naval air station would be originated by the
1. destination operations
2. FSS nearest the station
3. ARTCC nearest the station
4. destination FSS tie-in station

7-47. The originator of a flight advisory message must be notified if the message CANNOT be delivered within how many minutes?
1. 3
2. 5
3. 10
4. 15

Learning Objective: Identify conditions that require search and rescue (SAR) operations, functions of various agencies involved in these operations, and procedures followed in effecting search and rescue for both IFR and VFR flights.

7-48. Coordination of SAR operations in the conterminous United States is a responsibility of the
1. U.S. Air Force
2. Federal Aviation Agency
3. Joint Chiefs of Staff
4. International Civil Aviation Organization

7-49. Overall coordination of the SAR efforts of the various groups working together to find a missing aircraft in a particular area is the responsibility of the
1. ATCC
2. FSS
3. RCC
4. ARTCC

7-50. If a jet aircraft flying VFR fails to arrive at the ETA received from the last intermediate stop tie-in station, what period of time will elapse before an attempt is made by the destination tie-in station to locate the aircraft?
1. 15 min
2. 30 min
3. 45 min
4. 60 min

7-51. Under SAR procedures for overdue VFR aircraft, the FAA functions primarily to
1. participate directly as a searching activity along with the Armed Services
2. act as a communications link in SAR operations
3. perform rescue operations
4. act as SAR liaison

7-52. In the event that a jet aircraft for which a flight plan has been filed is overdue, an iformation request (INREQ) is initiated by the
1. departure base 1 hour after ETA
2. destination base 1 hour after ETA
3. departure base 30 minutes after ETA
4. destination base 30 minutes after ETA

7-53. An alert notice (ALNOT) can expand the search area for a missing aircraft to allow a communications search over a wider area than an INREQ.

7-54. Assume that an ALNOT was sent on a VFR flight that could NOT be located and the RCC suspended its search. What procedure should then be followed?
1. The originating station should advise RCC of the circumstances
2. The departure station should cancel the ALNOT
3. The originating station should send an ALNOT cancellation to all stations that received the ALNOT
4. The departure station should send an ALNOT cancellation to all stations that received the ALNOT

7-55. The station originating search and rescue of an overdue aircraft must, upon request, furnish the RCC with the positions and routes of all aircraft known to be along or near the route of the missing aircraft so that these aircraft can be used to assist in the search.

7-56. Which of the following statements best explains the absence of a standard SAR procedure in hazardous areas?
1. Remote areas do not have individual procedures
2. Specialized SAR units are always on the alert
3. Limited areas reduce the scope of SAR efforts
4. A variety of possible situations exists

7-57. The SAR procedure for an overdue IFR flight is initiated by the
1. FAS
2. FSS
3. RCC
4. ARTCC

7-58. Which of the following responsibilities is assigned to the ARTCC which makes the determination that an IFR flight is overdue?
1. To alert the appropriate RCC
2. To transmit an ALNOT to all ARTCCs along the route of flight from the last reported position to the destination
3. To transmit an ALNOT on all Area B circuits 50 nautical miles on both sides of the route from the last reported position to the destination
4. All of the above

7-59. Responsibility for further search for an overdue IFR flight is transferred to RCC 30 minutes after
1. ETA at the destination
2. radio contact is lost
3. estimated fuel exhaustion
4. issuing the ALNOT

Learning Objective: Recognize individual and activity responsibilities for originating and executing procedures under the notices to airmen (NOTAM) system, the meanings and format of a NOTAM accountability number, services provided by the parts of the NOTAM summary, and frequency of NOTAM display board posting.

7-60. In regard to NOTAM procedures, you as an AC would NOT be concerned with which of the following actions?
1. Preparing NOTAMs for dissemination
2. Receiving NOTAMs for posting
3. Posting NOTAMs to the NOTAM board
4. Transmitting civil NOTAMs

7-61. The USAF/USN NOTAM system is centrally coordinated and operated by the USAF Central NOTAM Facility (AFCNF) to provide both USAF and USN air activities with current NOTAMs.

7-62. The Naval Flight Information Group provides guidance and monitors Navy NOTAMs.

7-63. Which of the following is NOT a responsibility of originators of NOTAMs?
1. Notifying the commanding officer immediately of navaid malfunctions
2. Preparing NOTAMs for transmission on a specific circuit
3. Using the same accountability number for revision or cancellation of NOTAMs
4. Ensuring all stations receive the NOTAM

7-64. NAS Memphis GCA will be out of service in 72 hours. What is the maximum number of hours prior to the outage that AFCNF will accept a NOTAM?
1. 24
2. 48
3. 72
4. 96

7-65. The first two digits of a NOTAM identification code number enable AFCNF to determine if it has received all NOTAMs from a given base, and the second part enables each base to determine if it has received all retransmitted NOTAMs.

7-66. The two-digit NOTAM accountability numb is assigned by the
1. originator of the NOTAM
2. AFCNF
3. Air Force Communications Service
4. communications agency that transmit the message

7-67. Local aerodrome items, such as taxiing conditions, are considered non-NOTAM information.

7-68. Amplifying information included in the remarks section of a NOTAM, such as the time frame for the outage, makes this NOTAM a
1. new NOTAM
2. self-cancelling NOTAM
3. NOTAM time presentation
4. revised NOTAM

7-69. Which of the following types of NOTAMs will use an identification number that has previously been used to identify another type of NOTAM?
1. New
2. Revised only
3. Cancellation only
4. Revised and Cancellation

7-70. All dates and times expressed in NOTAMs are Greenwich Mean Time.

7-71. A NOTAM display board must be maintaine in accordance with what OPNAVINST (Seri
1. 3722.16
2. 3721.1
3. 3715.7
4. 3710.7

Assignment 8

Airport Lighting, Markings, and Equipment

Text: Pages 8-1 through 8-27

Learning Objective: Recognize factors to be considered in selecting an airport site, and identify airport markings.

8-1. In selecting a site for an airport, careful consideration must be given to an area adequate for both present needs and needs created by possible future expansion. In addition, what other factor(s) must be considered?
1. Terrain
2. Accessibility
3. Weather conditions
4. All of the above

8-2. Shifting winds, downdrafts, and air eddies are some of the many elements to be considered when selecting an airport site. These elements are classified under the general category of
1. area
2. terrain
3. weather conditions
4. accessibility

8-3. Which of the following factors is NOT taken into consideration when the length of an airport's primary runway is determined?
1. Location of the control tower
2. Principal types of aircraft that will be operated from the airport
3. Mean maximum temperature of the airport
4. Field elevation of the airport

8-4. Normally, runways at naval air bases are how wide?
1. 150 ft
2. 200 ft
3. 250 ft
4. 300 ft

8-5. Which of the following areas is used for checking aircraft instruments and radio equipment prior to takeoff?
1. Mat
2. Warmup
3. Runway
4. Overrun

8-6. Compass calibration pads are marked every 15 degrees to indicate magnetic bearings beginning with
1. magnetic south
2. true south
3. magnetic north
4. true north

8-7. A runway having the number 9 painted on one end has what number painted on its other end?
1. 5
2. 11
3. 16
4. 27

8-8. Which of the following runways is most likely to be found at an airport where the prevailing wind is from the west?
1. 5
2. 11
3. 16
4. 27

8-9. An airport with runway 16R must also have a runway numbered
1. 34L
2. 29
3. 23
4. 9R

In items 8-10 through 8-12, select from column B the type of line used to indicate each portion of a Navy airfield pavement markings listed in column A.

A. Paved surfaces		B. Types of line
8-10.	Primary runway centerline	1. Solid line, 12 feet wide, 150 feet long, painted retro-reflective white
8-11.	Primary runway edge	2. Broken line, 2 feet wide, painted retro-reflective yellow
8-12.	Threshold markings (runway 200 feet wide)	3. Solid line, 3 feet wide, painted retro-reflective white
		4. Broken line, 3 feet wide, painted retro-reflective white

8-13. A displaced threshold is a threshold at the beginning of the full strength runway pavement.

8-14. Runway distance markers are used as an aid to the pilot in determining which of the following factors?
1. The location of the arresting gear
2. The amount of runway left
3 The amount of runway used
4. Both 2 and 3 above

8-15. Lighted signs consisting of large yellow plexiglass arrows and white letters on a black background are placed on both sides of a runway to indicate the
1. FCLP areas
2. landing gear warnings
3. arresting gear locations
4. VOR/TACAN checkpoints

8-16. Taxiway centerline strips are 6 inches wide and painted what color?
1. White
2. Yellow
3. Retroreflective white
4. Retroreflective yellow

8-17. Upon reaching a position marked by two solid and two broken painted lines across the taxiway, the pilot should
1. stop, look around, and proceed if there is no traffic in sight
2. stop and then proceed at a minimum taxiing speed
3. stop and request further clearance
4. proceed at normal taxiing speed

8-18. A pilot is able to check his VOR/TACAN for proper functioning prior to flight by placing his aircraft on a special circle painted on the taxiway and using data painted on a sign adjacent to the taxiway.

In items 8-19 through 8-21, select from column the markings used to indicate each type of area listed in column A.

A. Areas		B. Markings
8-19.	Deceptive	1. Retroreflective yellow painted markings
8-20.	Hazardous	2. Diagonal black strips painted on an orange colored background
8-21.	Closed runway	3. Two yellow bands 10 feet wide and 60 feet long in the shape of an X
		4. Aviation surface orang and aviation white normally in a checker-board pattern

8-22. Runway shoulder markings are painted nonretroreflective yellow stripes and are placed 100 feet apart at a 45-degree angle to the approach end of the runway beginning at the runway midpoint.

Learning Objective: Recognize standards applicable to airfield lighting systems, and indicate functions of and operating rules for related components.

8-23. During periods when the airfield is closed, all associated lighting must be turned off.

8-24. Which of the following statements about an airport beacon is INCORRECT?
1. It always rotates at a constant speed to produce the effect of flashes at regular intervals
2. Its flashes may be of one color or two colors alternately at the rate of 12 to 15 per minute
3. It should be located within 750 ft of the centerline or centerline extended of the primary runway
4. It is operated in daylight hours when the visibility is under 3 miles and/or the ceiling is under 1,000 ft

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In items 8-25 through 8-27, select from column B the light display from a rotating beacon that has each meaning listed in column A.

	A. Meanings	B. Displays
8-25.	The location of a landmark or navigational point	1. Alternating green and white flashes
8-26.	A lighted airport or landing field within 2 miles	2. White flashes alone
		3. Alternating red and white flashes
8-27.	The presence of an obstruction or obstruction hazardous to air navigation	4. Red flashes alone

---

8-28. All required airport lighting must be operated for (a) how long prior to the ETA of an unreported aircraft, and (b) for what duration?
1. (a) 30 min (b) until 30 min after the aircraft's fuel is estimated to be exhausted
2. (a) 30 min (b) 30 min after ETA
3. (a) 30 min (b) 1 hr after ETA
4. (a) 1 hr (b) until the aircraft is located

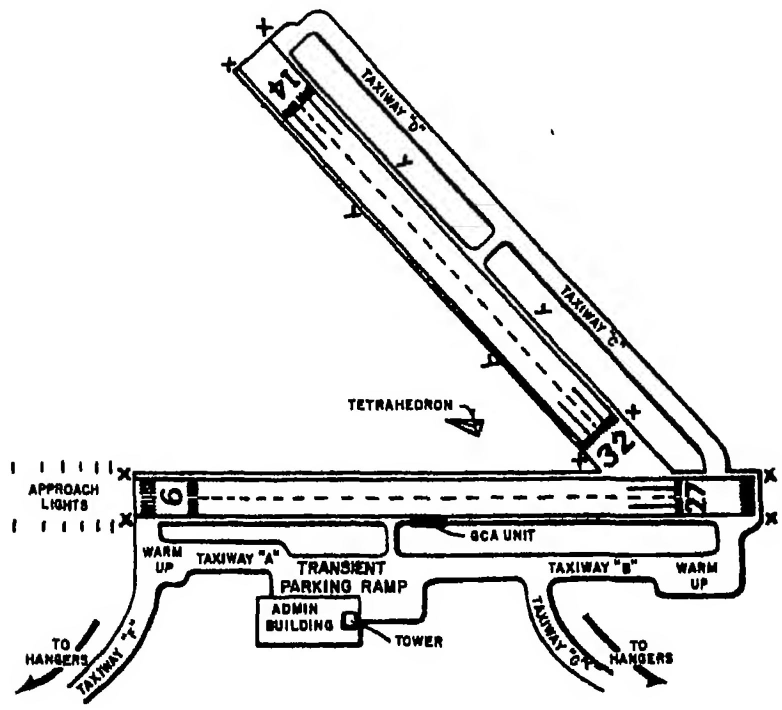

Figure 8A.--NAS Leadville.

● Refer to figure 8A in answering items 8-29 and 8-30.

8-29. If runway 14-32 is 5,000 feet long, what is the minimum number of pairs of lights required to light it?
1. 20
2. 25
3. 40
4. 50

8-30. What type and color lights are installed at the points marked with Xs?
1 Pairs of blue range lights
2. Split green and red threshold lights
3. Groups of yellow contact lights
4. Pairs of split yellow-white contact lights

In items 8-31 through 8-33, select from column B the color associated with each airport light listed in column A.

	A. Lights	B. Colors
8-31.	Runway edge	1. Bluish-white
8-32.	Threshold	2. Bidirectional white
8-33.	Runway centerline	3. Bidirectional green and red
		4. Bidirectional white and red

8-34. Runway End Identification Lights (REIL) rotate at a constant speed of
1. 10 rpm
2. 20 rpm
3. 30 rpm
4. 40 rpm

8-35. On a straight segment of taxiway over 300 feet in length, the spacing between taxiway lights may approach but NOT exceed how many feet?
1. 5
2. 50
3. 100
4. 200

8-36. The halo sometimes produced by high intensity approach lights can be caused by the
1. aircraft's approach being too low
2. intensity being set too high
3. intensity being set too low
4. aircraft's approach being too high

8-37. Refer to table 8-2 in your textbook. What is the recommended intensity setting for high intensity approach lights when the visibility at night is less than 1 mile?
1. 1
2. 2
3. 3
4. 4

8-38. The Visual Approach Slope Indicator (VASI) is designed for use during IFR conditions.

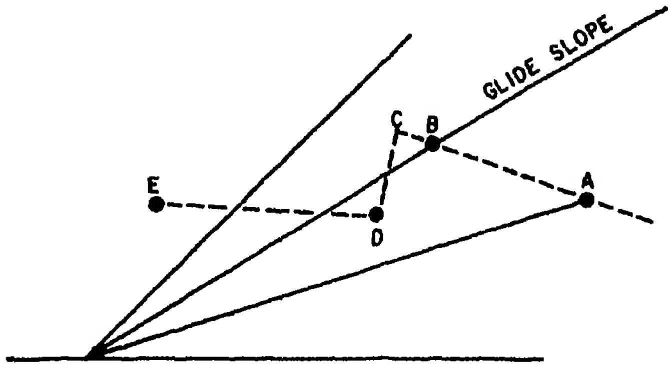

Figure 8B.--VASI glide slope.

In items 8-39 through 8-41, refer to table 8-3 in your textbook and to figure 8B. Select from column B the combination of lights a pilot will observe while flying through the various points of the VASI glide slope indicated in column A.

	A. Points on the VASI glide slope	B. Light combinations
8-39.	A	1. White White
8-40.	B	2. Red Red
8-41.	C	3. Red White
		4. White Red

8-42. What is the function of the red lights that are spaced along the approach end of the runway in clusters 800 feet apart and that flash 90 times a minute when activated?
1. To warn the pilot of obstructions along the runway
2. To identify the runway distance markers
3. To serve as a wheels-up warning
4. To identify the runway

8-43. An airport's red obstruction lights are turned on during daylight hours whenever flight visibility is restricted.

8-44. A Fresnel Lens Optical Landing System installed along the side of a heavily used runway permits pilots to
1. practice field carrier takeoffs
2. field carrier landing practice (FCLP) approaches
3. check their landing gear on approaches
4. ensure that no aircraft are behind and above them while landing

8-45. How are the colored lights arranged on a wind tee so that an airborne pilot can accurately determine wind direction at night?
1. Green on the fore and aft bar, green on the crossbar
2. Red on the fore and aft bar, green on the crossbar
3. Red on the fore and aft bar, amber on the crossbar
4. Green on the fore and aft bar, amber on the crossbar

8-46. Restriction or suspension of VFR operations within the control zone may be indicated between sunset and sunrise by flashing lights on the
1. windcone
2. tetrahedron
3. control tower
4. airport beacon

8-47. An approximation of wind velocity is given by which of the following types of wind direction indicators?
1. Windcone
2. Wind tee
3. Tetrahedron
4. All of the above

Learning Objective: Identify the different types of emergency recovery equipment and their uses.

8-48. Mobile control facilities are used to serve which of the following functions?
1. To provide coordination with the primary control tower controllers when special aircraft operations or tests/evaluations are being conducted on the field
2. To provide coordination with the landing signal officer (LSO) during times when field carrier landing practice (FCLP) is being conducted
3. To provide temporary operating facilities during periods of equipment outage in the main control tower
4. All of the above

8-49. When weather reports indicate severe weather activity is approaching, auxiliary power generators which are NOT equipped with automatic transfer, must be activated at least how long before the severe weather is anticipated?
1. 5 min
2. 10 min
3. 15 min
4. 30 min

8-50. Who has the responsibility for providing firefighting, crash, ambulance, and rescue equipment and for ensuring that this equipment is properly staffed, alertly manned, and is in good operating condition during flight operations?
1. The operations officer
2. The flight officer
3. The commanding officer
4. The safety officer

8-51. Although the crash bill normally incorporates the details and personnel responsibilities to be executed should an aircraft crash occur, instructions for specific handling of accidents involving which of the following areas are normally separate from the crash bill?
1. Hazardous cargo
2. VIP personnel
3. Helicopters
4. All of the above

8-52. The primary crash alarm system is normally wired directly between the control tower and what facility(ies)?
1. The crash/rescue alarm room and the structural fire alarm room
2. The air operations dispatcher and the AirOps duty office
3. The station hospital or dispensary
4. All of the above

8-53. All of the emergency facilities at an air station are normally connected to a crash phone circuit which is activated from either the tower or flight clearance desk. This allows amplifying information to be transmitted by the flight clearance dispatcher and permits the tower operator to return to his duties without further interruption.

8-54. The secondary emergency radio network used as a standby for the primary crash radio network which the tower uses to communicate with mobile units is called the
1. operational control network
2. crash truck network
3. safety control network
4. internal security network

8-55. In the event of an aircraft crash, control tower personnel activate the crash phone system to inform the units concerned of the crash and its location. In addition, they also give the essential personnel which of the following information?
1. The ordnance load, if known
2. The type of aircraft
3. The number of persons aboard
4. All of the above

8-56. The location of a crashed aircraft with reference to a grid chart should be given in terms such as
1. FIVE DELTA
2. ONE-HALF MILE SOUTH OF TOWER
3. TWO MILES OFF THE END OF RUNWAY THREE SIX
4. JUST INSIDE THE FENCE NEAR THE SOUTHEAST CORNER OF THE FIELD

8-57. A wheels watch, equipped with a set of LSO paddles, is posted at the approach end of the duty runway. His duties are to monitor the wheels of approaching aircraft. Which of the following is a correct signal to the pilot?
1. A roger sign indicating the wheels are "down"
2. A roger sign indicating the wheels are "up"
3. A roger sign indicating the wheels "appear down and in place"
4. A waving motion indicating the wheels "appear down and in place"

8-58. When the emergency chain-type arresting gear is used, the force that arrests an aircraft is caused by the transfer of energy from
1. the arrested aircraft to the chain
2. the chain to the arrested aircraft
3. the cross desk pendants to the arrested aircraft
4. the arrested aircraft to the cross deck pendants

● Items 8-59 through 8-62 pertain to the E-28 emergency runway arresting gear.

8-59. This gear requires no initial preparation to accommodate aircraft of various weights and landing speeds.

8-60. It is anticipated that this gear will eventually replace all other types of arresting gear ashore because of its
1. fast recycle time only
2. reliability only
3. simplicity only
4. simplicity, reliability, and fast recycle time

8-61. During an arrestment, the motion of the rotor is resisted by
1. movement of the cam release post
2. turbulence of the fluid in the housing
3. engagement of the retrieve drive sprocket
4. movement of the tape drum in the opposite direction

8-62. The size and exposed area of the cooling tank provide the means by which the excess heat generated by resistance to the turbulence is dissipated to the outside air.

Assignment 9

Air Traffic Control Communications

Text: Pages 9-1 through 9-28

Learning Objective: Select those ATC facilities connected by interphone circuits, and state the priorities and correct procedures used over these circuits.

9-1. Communications circuits of a facility's interphone system are divided into what two categories?
1. Local and intercom lines
2. Intercom and telephone lines
3. Local and long lines
4. Long and telephone lines

9-2. Which of the following facilities is NOT connected to an airport's local line?
1. Weather
2. GCA
3. ARTCC
4. Base operations

9-3. What long line circuit, maintained by the FAA, is used to relay aircraft movement and control messages?
1. Area B
2. Center B
3. Utility B
4. Service F

9-4. Which of the following types of messages is classified as a control message?
1. ATC clearance
2. IFR flight plan
3. Arrival report
4. Progress report

9-5. Which of the following messages has the lowest priority in interphone communications?
1. A flight plan
2. A departure report
3. An ATC instruction or clearance
4. A movement message on a VFR aircraft

9-6. When long lines to relay flight related messages are used, which of the following statements is/are correct?
1. Pay special attention to numerals
2. When doubt exists as to the accuracy of a message, repeat the essential parts
3. Voice recorders may be used to record the messages
4. All of the above

9-7. How are messages transmitted over Service F terminated?
1. By stating the operating initials of the speaker
2. by stating the word OVER
3. By stating the word OUT and the time
4. By stating the facilities name and the words ROGER OUT

9-8. When ACs transmit a message on an interphone communications system, which of the following actions should they NOT take?
1. Use the phonetic alphabet to spell peculiar words
2. Speak into the handset in a moderate tone
3. Pronounce all words clearly
4. Speak faster than the receiving operator can accurately copy

Learning Objective: Identify those general communication procedures and rules common to all air traffic control communications.

9-9. When a control tower watch is relieved, the oncoming watch will normally check the usability of both the radio transmitters and receivers by making short transmissions on each of the assigned frequencies from each operating position with the receivers off at the transmitting position but on at the other positions.

9-10. Regardless of the desired level of volume, the controller must ascertain that the volume of his headset or speaker is NOT reduced to the extent that transmissions from aircraft within his area of responsibility CANNOT be clearly heard.

9-11. Proper modulation of a transmitter at one operating position is determined audibly by setting the receiver switch of another operating position to ON and speaking into the microphone in a normal conversational manner.

9-12. At most naval ATC facilities, all tower and approach control radio frequencies are continuously monitored by controllers using headsets and/or speakers.

9-13. Procedures designed to deny the enemy valuable information concerning military operations transmitted by radio are referred to by what abbreviation?
1. SECCOM
2. COMSEC
3. COMGUARD
4. RADSEC

9-14. Defensive measures which should be used to guard against possible enemy interception of radio transmissions include which of the following?
1. Alternating frequencies on a daily basis
2. Using the lowest transmitter power possible and minimum transmission time
3. Maintaining correct adjustment of equipment and circuit discipline
4. Both 2 and 3 above

9-15. Procedures used to reduce the possibility of enemy interception of radar and radio transmissions from a carrier task force are called
1. EMCON
2. RADCOM
3. CONELRAD
4. ECOMCON

9-16. The responsibility for determining the requirements and implementation of electronic emission control rests with the
1. operations officer
2. communications officer
3. appropriate fleet commander
4. commanding officer

9-17. FAR 99.7 refers to special security instructions issued by the FAA Administrator which apply equally to the FAA and DOD.

9-18. The U.S. Navy instruction that promulgates the participation of naval units in the SCATANA plan is OPNAVINST
1. 3222.30 (Series)
2. 3722.30 (Series)
3. 3730.22 (Series)
4. 2237.30 (Series)

9-19. The instruction that outlines the responsibilities and actions for the SCATANA plan also provides for testing the plan at least once every
1. 15 days
2. 30 days
3. 45 days
4. 60 days

9-20. When a SCATANA test is conducted, all but which of the following actions will be simulated?
1. Interrupting communications
2. Completing the SCATANA Test Report
3. Grounding or diverting aircraft
4. Shutting down all NAVAIDs

9-21. Emergency communications are communications associated with which of the following situations?
1. An aircraft that is in distress
2. A pilot who is lost
3. Alerting a pilot to a dangerous situation
4. All of the above

In items 9-22 and 9-23, select from column B the radiotelephone transmission associated with each type of emergency signal listed in column A.

	A. Emergency Signals	B. Transmissions
9-22.	Distress	1. PAN PAN PAN
9-23.	Urgency	2. SECURITY SECURITY SECURITY
		3. MAYDAY MAYDAY MAYDAY
		4. URGENT URGENT URGENT

9-24. If a message from an aircraft is preceded with the words CIRVIS CIRVIS CIRVIS, the frequencies must be cleared of all other communications EXCEPT distress and urgency.

9-25. Which of the following examples contains information that would most likely be the subject of an initial sighting CIRVIS report?
1. The Air Force identified the formation of six jet aircraft as B-52s flying from Kansas City to Oregon on a heading of 270° at an altitude of 35,000 feet with an airspeed of 330 knots
2. Six Air Force B-52s were observed 20 nautical miles from a lightship at approximately 35,000 feet heading north over the continental limits of the United States
3. A formation of jet aircraft, no insignia observed, was sighted flying over the Pacific Ocean at 35,000 feet on an easterly course
4. The lightship HOTEL identified jet aircraft previously identified on a westerly heading at 35,000 feet as six USAF B-52s

9-26. Navy towers pass CIRVIS reports directly to the appropriate Air Division Control Center.

Learning Objective: Recognize proper radio transmission procedures including phraseology and station identification.

9-27. The initial radio callup normally ends with what word?
1. WILCO
2. ROGER
3. OVER
4. OUT

9-28. The pilot of an F-8 contacts a Navy tower using NAVY 12345 as his call sign and identifies the type of aircraft. After the tower has acknowledged by repeating this call sign, what shorter version may be used?
1. NAVY TWO THREE FOUR FIVE
2. NAVY THREE FOUR FIVE
3. NAVY FOUR FIVE
4. NAVY FIVE

9-29. Which of the following responses is NOT an accurate response to a request for a radio check?
1. LOUD AND GARBLED
2. WEAK AND UNREADABLE
3. WEAK BUT CLEAR
4. UNREADABLE

In items 9-30 through 9-32, select from column B the organization responsible for the control facility associated with each abbreviation listed in column A.

	A. Abbreviations	B. Organizations
9-30.	ARACs	1. Air Force
9-31.	RAPCONs	2. Army
9-32.	ARTCCs	3. Navy
		4. FAA

9-33. Memphis International Airport is in close proximity to and provides approach control service for NAS Memphis. What is the correct phraseology to identify the precision approach radar (PAR) at NAS Memphis?
1. MEMPHIS RADAR
2. MEMPHIS PRECISION APPROACH
3. NAVY MEMPHIS GCA
4. NAVY MEMPHIS PAR

9-34. The word AIRWAYS identifies communications stations operated by what activity?
1. The Navy
2. The Air Force
3. A commercial airline
4. The Federal Aviation Administration

In items 9-35 through 9-37, select from column B the type of operating activity associated with each aircraft identification listed in column A.

	A. Aircraft Identification	B. Operating Activity
9-35.	NOVEMBER TWO ONE FIVE FOUR	1. Foreign civil
		2. Interceptor
9-36.	C-F-M-R-C	3. Civil
9-37.	CANFORCE FIVE SIX ONE FOUR	4. Canadian military

9-38. If Navy aircraft 53142 is on a search and rescue mission, it is identified in which of the following ways?
1. NAVY SAR FIVE THREE ONE FOUR TWO
2. NAVY RESCUE FIVE THREE ONE FOUR TWO
3. NAVY RESCUE FIFTY THREE ONE FORTY TWO
4. SIERRA ALFA ROMEO FIVE THREE ONE FOUR TWO

9-39. If a pilot uses an aircraft call sign identification other than those recommended, the Air Controller should use the same call sign in his reply.

In items 9-40 through 9-42, select from column B the word associated with each special meaning listed in column A.

A. Meanings	B. Words
9-40. Let me know that you have received and understand this message	1. ROGER
	2. WILCO
9-41. I have received your message, understand it, and will comply	3. ACKNOWLEDGE
	4. AFFIRMATIVE
9-42. I have received all of your transmission	

9-43. An altitude of 1,800 feet is transmitted as
1. EIGHTEEN HUNDRED
2. ONE EIGHT HUNDRED
3. ONE EIGHT ZERO ZERO
4. ONE THOUSAND EIGHT HUNDRED

9-44. A flight level equivalent of 24,000 feet is transmitted as
1. TWO FOUR ZERO ZERO ZERO
2. FLIGHT LEVEL TWENTY FOUR
3. FLIGHT LEVEL TWO FOUR THOUSAND
4. FLIGHT LEVEL TWO FOUR ZERO

9-45. In response to a request for a time check, how is the time 5:15 and 20 seconds a.m. transmitted?
1. TIME, FIVE FIFTEEN
2. TIME, ZERO FIVE ONE FIVE
3. TIME, ZERO FIVE ONE FIVE AND ONE QUARTER
4. TIME, ONE SEVEN ONE FIVE AND ONE QUARTER

9-46. An AC at an airport that has a field elevation of 1,800 feet would transmit this information as
1. FIELD ELEVATION EIGHTEEN HUNDRED
2. FIELD ELEVATION EIGHTEEN ZERO ZERO
3. FIELD ELEVATION ONE EIGHT ZERO ZERO
4. FIELD ELEVATION ONE THOUSAND EIGHT HUNDRED

9-47. How is an altimeter setting of 29.86 spoken?
1. ALTIMETER TWO NINER EIGHT SIX
2. ALTIMETER TWENTY NINER DECIMAL EIGH SIX
3. ALTIMETER TWO NINER POINT EIGHT SIX
4. ALTIMETER TWENTY NINER POINT EIGHTY SIX

9-48. NAS control tower has received a weathei report from the local Naval Weather Service (NWS) office which indicates a surface wind of 110 degrees, velocity 25 knots. In relaying this information to an aircraft, the correct phraseology would be
1. WIND ONE TEN DEGREES AT TWO FIVE
2. WIND, ONE ONE ZERO AT TWO FIVE
3. WIND FROM ONE ONE ZERO DEGREES, TWO FIVE KNOTS
4. WIND, ONE ONE ZERO AT TWENTY FIVE KNOTS

9-49. The word KNOTS must be used when you ar using speed adjustment procedures.

9-50. Stating the letter J and a route number in group form is the proper way to describe a/an
1. VOR/VORTAC/TACAN JET ROUTE
2. VOR/VORTAC/TACAN AIRWAY
3. RNAV ROUTE
4. ARC ABOUT VOR-DME/VORTAC/TACAN NAVA

9-51. When describing a particular arc about TACAN that is 25 nm SE of a NAVAID, a controller would transmit this informat to an aircraft as
1. TWO FIVE MILE ARC SOUTHEAST OF MEMPI
2. TWENTY FIVE MILE ARC OF MEMPHIS TAC SOUTHEAST
3. MEMPHIS TACAN TWO FIVE MILE ARC, SOUTHEAST
4. SOUTHEAST OF MEMPHIS TACAN, TWENTY FIVE MILE ARC

9-52. Which of the following items of a taxi clearance to a departing aircraft may b omitted when so requested in writing by a local aircraft operator?
1. The runway in use
2. The altimeter setting
3. The surface wind
4. The departure control frequency

9-53. When a taxi clearance is issued, the omission of any holding instruction authorizes the aircraft to cross all runways the taxi route intersects excep the runway to which cleared.

9-54. What instruction will the controller give to a pilot granting permission to take off and make a requested turn to the left when airborne?
1. TAKEOFF, TURN LEFT
2. CLEARED FOR TAKEOFF AND LEFT TURN
3. LEFT TURN APPROVED, WIND TWO FOUR ZERO AT ONE ZERO, CLEARED FOR TAKEOFF
4. CLEARED FOR TAKEOFF, LEFT TURN APPROVED

9-55. A control tower that does NOT possess override capability on the departure frequency prefixes IFR takeoff clearances with which of the following transmissions?
1. CHANGE TO DEPARTURE, MONITOR GUARD
2. CHANGE TO DEPARTURE CONTROL FREQUENCY, MONITOR GUARD CHANNEL
3. CONTACT DEPARTURE CONTROL, MONITOR GUARD FREQUENCY
4. MONITOR GUARD CHANNEL, CHANGE TO DEPARTURE CONTROL

9-56. Single piloted jet aircraft should NOT be instructed to change radio frequencies prior to reaching 2,500 feet.

9-57. If an aircraft approaches a traffic pattern which requires the aircraft to circle the airport to the right, the controller must furnish specific traffic pattern information to the pilot.

9-58. If a pilot turns his aircraft onto the final approach leg and requests a touch-and-go landing that CANNOT be approved but a full stop can be approved, which of the following instructions should the controller transmit to the pilot?
1. UNABLE TOUCH-AND-GO, MAKE FULL STOP LANDING OR GO AROUND
2. UNABLE TOUCH-AND-GO, CIRCLE THE FIELD
3. Either 1 or 2 above
4. UNABLE TOUCH-AND-GO, RIGHT/LEFT TURN APPROVED

9-59. Which of the following transmissions constitutes the most acceptable description of the location of an airborne obstacle that might affect the pilot of an aircraft in the traffic pattern?
1. TO YOUR RIGHT, ABOVE YOU, ONE MILE AHEAD OF YOU
2. ABOVE YOU AND ONE MILE EAST OF YOU
3. ONE MILE EAST OF THE TELEVISION TOWER ON YOUR LEFT AND ABOVE
4. ONE MILE EAST OF THE TELEVISION TOWER WHICH IS EAST OF YOU AND DIRECTLY ABOVE THE TOWER

9-60. If a pilot requests a landing gear check by control tower personnel and the check shows the gear to be in a normal down position, the controller should transmit LANDING GEAR APPEARS DOWN AND IN PLACE.

9-61. OPNAVINST 3721.1 requires all EXCEPT which of the following frequencies to be recorded independently?
1. VHF emergency
2. Primary tower
3. Primary ground control
4. Primary approach control

9-62. Voice recorders must be checked for proper operation at the beginning of each watch, and if the equipment fails, all communications must be written in the tower log.

9-63. Recorded reels of tape must be kept on file for at least 10 days before they are reused or erased.

9-64. The primary purpose of ATIS at airports is to provide arriving and departing passengers with current arrival and departure schedules.

9-65. A system of identifying ATIS messages has been established which precludes a pilot from receiving outdated information. This identification includes the
1. airport name and datetime group
2. alphabet code of message, datetime group, and airport name
3. airport name and phonetic alphabet code of message
4. alphabet code of message, airport name, and time

9-66. Recordings made of communications between air traffic control facilities and aircraft are used for which of the following purposes?
1. Circuit discipline
2. Aircraft accident analysis
3. Voice training of air traffic control personnel
4. All of the above

Assignment 10

Control Tower Equipment and Operations

Text: Pages 10-1 through 10-37

Learning Objective: Identify and describe the use of various equipment found in most naval control towers.

10-1. Inasmuch as a single-piloted IFR aircraft should be provided with a single frequency approach, it may be necessary for the control tower, the radar facility, and approach control to operate on the same frequency during the approach of such an aircraft.

● Items 10-2 through 10-7 refer to the AN/FSA-52(V) communications console.

10-2. This system provides as many as 23 transmit/receive channels, 13 of which may be used for voice communications and 10 for interphone.

10-3. If you want to transmit while monitoring a frequency, you should place the pertinent radiophone switch in its full-up position.

10-4. Relative to the control switch position on the receiver, under what circumstances will the receiver's amber indicator light glow when a signal is received?
1. Provided the control switch is in the MONITOR position
2. Provided the control switch is in the TRANSMIT position
3. Provided the control switch is in the RECEIVE position
4. Irrespective of the position of the control switch

10-5. If a radio call is received on the frequency controlled by radiophone switch No. 17, a green light above this switch will glow if the switch is in its middle or full-up position.

10-6. What is the color of the indicator light that is located above each interphone switch and which glows when the position is called by another operator?
1. Red
2. Blue
3. Green
4. Yellow

10-7. A signal received by any one of the receivers is automatically and simultaneously fed to the overhead speakers and headsets.

10-8. The only undesirable feature of the AN/FSA-58 communications console is the absence of a backup power supply in the event of primary power failure.

10-9. When the AN/FSA-58 communications console is used, a controller's position normally consists of how many modules?
1. One
2. Two
3. Three
4. Four

10-10. Relative to an operator depressing the XMTR SEL button on the AN/FSA-58 radiophone module, which of the following statements is correct?
1. The green light at the controller's position will glow a steady bright
2. The white light at the supervisor's console will flash
3. The red light at the controller's position will glow at half brilliance
4. The yellow light at the supervisor's console will flash

10-11. An indication that a controller has selected the TELCO position on the AN/FSA-58 communications jackbox is the glowing of the
1. flashing red light on the module
2. flashing green light on the jackbox
3. steady white light on the module
4. steady green light on the jackbox

)-12. A microphone is a device used to convert sound energy into electrical energy.

)-13. How should a hand-held microphone be held?
1. Within one-half inch of the lips
2. With the lips just touching it
3. With the lips firmly against it
4. Within six inches of the lips

)-14. Which of the following techniques is NOT considered proper microphone technique?
1. Speak clearly and distinctly
2. Avoid extremes of voice pitch
3. Shield your microphone from outside noises
4. Use more than one microphone at a time

)-15. The maximum number of minutes of recording possible with the RD-217/UNH recorder-reproducer without tape change is
1. 1,425 min
2. 1,440 min
3. 1,455 min
4. 1,420 min plus a 15-minute overtime allowance

0-16. One of the most desirable features that the RD-379(V)/UNH recorder possesses is the ability to simultaneously record how many channels?
1. 3
2. 5
3. 10
4. 12

0-17. The RD-379(V)/UNH is a solid-state recording system.

0-18. How many identical tape transport assemblies does the RD-279(V)/UNH contain?
1. One
2. Two
3. Three
4. Four

0-19. It is normal practice to record time on one channel. This recorded time signal is displayed in what order?
1. Seconds-days-hours-minutes
2. Days-hours-minutes-seconds
3. Hours-minutes-seconds-days
4. Seconds-minutes-hours-days

10-20. The RP-214(V)/UN is capable of reproducing how many channels?
1. One channel only
2. Two channels simultaneously
3. Three channels simultaneously
4. Four channels simultaneously

10-21. Which of the following statements is applicable to a wind velocity indicator installed in an NAS control tower?
1. It is used as a standby and referred to only during an emergency
2. It presents noncorrected information to be relayed to the pilot
3. It is usually slaved to one in the weather service department
4. It must be slaved to one in the weather service department

10-22. The weather service wind direction indicator readings indicate that the wind is from 074° magnetic at 14 knots at the same time the wind indicator readings from the control tower are compared. Corrective action must be taken on the control tower indicator if its direction and speed indications are
1. 070° at 16 kn
2. 071° at 18 kn
3. 072° at 17 kn
4. 079° at 10 kn

10-23. If comparison between the altimeter setting indicator in the control tower and the weather service official indicator shows the reading of the former to be 0.02 inch greater than that of the latter, maintenance personnel must be advised of the discrepancy immediately.

10-24. The initial input into a digital-type altimeter setting indicator is accomplished automatically.

10-25. The portable traffic control light can be used for directing takeoffs and landings of aircraft NOT equipped with radio.

10-26. When the selector handle of the portable traffic control light is turned fully counterclockwise and the operator holds the spring-loaded toggle switch in the pistol-type grip in its depressed position, a flashing red light is produced.

10-27. What is the visual range of the portable traffic control light during daylight hours?
1. 10 mi
2. 15 mi
3. 20 mi
4. 25 mi

In items 10-28 through 10-30, select from column B the traffic control light signal for aircraft in flight associated with each meaning in column A.

	A. Meanings	B. Signals
10-28.	Give way to other aircraft and continue circling	1. Steady red
10-29.	Cleared to land	2. Steady green
10-30.	Airport unsafe--do not land	3. Flashing red
		4. Flashing green

10-31. Which of the following statements about the performance of the AN/GSA-35 NAVAID monitor is NOT correct?
1. It voice modulates VOR, TACAN, and UHF HOMER transmitters
2. It establishes voice communications between the remote locations and the console
3. It provides manual control of TACAN, VOR, and UHF HOMER transmitters
4. It shuts down or restores to operation any of the transmitters at the transmitter location

10-32. RVR may be used by the tower, in lieu of the reported visibility, in the approval of straight-in instrument approach procedures.

10-33. When RVR equipment is operated, the reading in the window must be multiplied by what factor for the actual RVR value?
1. The distance from the aircraft
2. 10
3. 100
4. 1,000

10-34. What control tower position uses the BRITE-2 system to assist in the spacing of arriving and departing aircraft?
1. Ground controller
2. Tower supervisor
3. Local controller
4. Flight data controller

10-35. The requirement for a BRITE system is made necessary by which of the following factors?
1. The wide range of approach speeds
2. The large airport landing areas
3. The varying visibility conditions
4. All of the above

10-36. In addition to providing the control tower with surveillance coverage, the BRITE system also provides a precision radar display to facilitate monitoring the final approach course.

10-37. The system's TV camera is located in the equipment room where it views the radar information presented on the cathode-ray tube (CRT) of the plan position indicator (PPI) and transmits this information via coaxial cable to the TV display unit located in the tower cab.

10-38. When a controller selects the 30 nm range scale on the BRITE range selector, the corresponding range marks will automatically adjust to
1. 3
2. 5
3. 6
4. 10

10-39. A system which provides a series of lights and switches between the control tower and the radar final controller and serves to reduce voice contacts is called
1. BRITE-2
2. AN/FSA-17
3. VISCOM
4. CRT

10-40. When the AN/FSA-57 is used, what does a flashing green light indicate?
1. The tower controller clears the radar controller's aircraft to land
2. The aircraft on radar is approaching 3 miles from touchdown and requests a touch-and-go, low approach, or landing
3. The radar controlled aircraft has reached a point 6 miles from touchdown and clearance is requested to 3 miles
4. An aircraft has entered the ATC system and is requesting a radar approach

10-41. Control tower equipment out of adjustment or otherwise inoperative creates hardships for you and other controllers.

Learning Objective: Identify some of the general procedures applicable to control tower operations.

0-42. Which of the following is NOT considered a dual responsibility between the pilot and air traffic controller?
1. Publications
2. Communications
3. Coordination
4. Cooperation

0-43. For tower controllers to be considered fully qualified, they must possess a facility rating for the airport to which they are assigned.

0-44. The controller's repetitious, routine approval of pilot actions is NOT necessary under preventive control unless traffic conflicts develop.

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n items 10-45 through 10-47, select from column the air traffic control tower operating posi-ion which exercises supervision over each perational function listed in column A.

	A. Operational Functions	B. Operating Positions
0-45.	Separation of IFR traffic	1. Local control
		2. Ground control
0-46.	Control of VFR traffic	3. Approach control
0-47.	Handling taxiing traffic	4. Flight data position

0-48. The information entered in the control tower log is limited by regulations to entries relating to tower equipment, airport lighting facilities, runways, and communications.

0-49. The procedure for tower log entries concerning weather conditions, emergencies, and crashes can and does vary from one control tower to another.

10-50. How long are flight strips normally kept?
1. One year
2. Until the persons who entered the data on them are transferred
3. Three months
4. As long as considered necessary

10-51. Traffic conditions are the only basis upon which a request to make a low approach can be denied.

10-52. If an aircraft makes a low pass to allow a visual check of its landing gear and the controller suspects that it is malfunctioning, he should immediately inform the pilot and alert the crash and rescue crew.

10-53. Which of the following items might NOT be considered field condition information?
1. A maintenance truck is on the left side of the runway
2. Construction is in progress in a flag-marked area
3. A mower is operating in the center of the field
4. All traffic patterns are left-hand patterns

10-54. Which of the following statements correctly describes to a pilot that a mower is parked near the runway?
1. WATCH OUT FOR THAT MOWER
2. DON'T WORRY ABOUT THAT MOWER
3. MOWER TO LEFT OF RUNWAY
4. MOWER PARKED ON YOUR RIGHT NEAR THE INTERSECTION OF RUNWAY 28

10-55. Which of the following transmissions of weather elements may an AC make without consulting a weather report or weather service personnel?
1. VISIBILITY ONE ZERO
2. MEASURED CEILING FOUR THOUSAND OVERCAST
3. PATCHY FOG EAST OF AIRPORT
4. GROUND FOG DEPTH FIFTY FEET

10-56. Unless deemed unnecessary due to visual tracking or canceling reports, a tower operator should keep pilots informed of bird migrations, sizes, species, and courses of flight in the control area for what length of time after receiving bird activity information?
1. 5 min
2. 15 min
3. 30 min
4. 45 min

10-57. If a runway use program is NOT established for a particular airport and the surface wind velocity is 25 knots, the duty runway will normally be the runway most nearly aligned with the wind.

10-58. The pilot of a departing aircraft must use the runway specified by the controller even though it is operationally advantageous to use another.

10-59. A "FOLLOW ME" truck is normally used at air stations to help pilots unfamiliar with the field to move about expeditiously.

10-60. If a jet is ready for takeoff and another aircraft is coming in for a landing, priority will be granted to the jet if the pilot requests it; the other aircraft will be instructed to circle the field unless it is another jet, and aircraft in an emergency, or a hospital evacuation aircraft.

● Refer to figure 10-29 in your textbook in answering items 10-61 through 10-64 and assume that the control tower is adjacent to and south of the midpoint of runway 27.

10-61. In what general direction should the controller normally look to see an aircraft on the downwind leg for runway 9?
1. North
2. East
3. South
4. West

10-62. A pilot radios the tower that he is turning base for runway 9. What is his approximate heading after he has completed the turn onto the base leg?
1. 090°
2. 180°
3. 270°
4. 360°

10-63. The breakpoint for a standard overhead approach pattern for high performance military aircraft is usually over
1. a point 3 miles ahead of the approach end of the runway
2. the center of the runway
3. the jet initial point
4. the threshold of the runway

10-64. In a standard jet approach pattern, when the rollout on final approach is made, the distance of the aircraft from the threshold of the runway and its altitude above the ground should NOT be less than
1. 1/4 mi and 300 ft, respectively
2. 1/2 mi and 400 ft, respectively
3. 3/4 mi and 500 ft, respectively
4. 1 mi and 600 ft, respectively

10-65. When a pilot states "have numbers" or a similar phrase, which of the followi information may NOT be omitted?
1. Supplementary information, such as wheels down check
2. Specific traffic pattern informati
3. Runway in use
4. Surface wind

10-66. As a tower controller, you may omit th altimeter setting advisory to an arriv aircraft when
1. the pilot advises "have numbers"
2. the aircraft is vectored to the ai port by approach control
3. the altimeter setting hasn't chang in the last hour
4. you are transmitting simultaneousl on all assigned frequencies

10-67. The sequencing of arriving aircraft in the traffic pattern is established by
1. requiring the aircraft to adjust flight as necessary to achieve proper spacing
2. allowing only one aircraft on down wind at any given time
3. delegating visual separation to pi of all aircraft in the pattern
4. requiring all aircraft to make a straight-in approach

10-68. Records indicate that an unusually lar portion of midair or near-midair colli sions occurs during periods of good weather conditions when pilots are fly under visual air regulations.

Assignment 11

Control Tower Equipment and Operations

Text: Pages 10-37 through 10-50

Learning Objective: Recognize responsibilities of pilots and tower personnel relative to control tower operations.

11-1. An aircraft may be cleared for a low approach while another aircraft is on the landing runway providing the
1. approaching aircraft is given an altitude restriction of not less than 500 feet above the airport
2. approaching aircraft is advised of the other aircraft's position
3. aircraft on the runway is advised to hold in position
4. approaching aircraft is given an altitude restriction of not less than 500 feet above the airport and the aircraft on the runway is not in takeoff position or departing

11-2. VFR separation standards between arriving aircraft require the first aircraft to be off the landing runway before the second aircraft
1. has touched down
2. penetrates the airfield boundary
3. crosses the landing threshold on final
4. reports at a point not more than 2 miles on final

11-3. Reduced runway separation minimums between different categories of arriving aircraft using the same runway can be used between sunrise and sunset.

11-4. For the purpose of airport traffic control, which of the following types of propeller-driven aircraft is classified as category II?
1. Heavy twin-engine
2. Lightweight twin-engine
3. Lightweight single-engine
4. Higher performance single-engine

11-5. Refer to figures 10-30 and 10-32 in your textbook. What minimum separation must exist between an arriving category II aircraft and a succeeding category III aircraft at the time the category III aircraft crosses the landing threshold?
1. 3,000 ft
2. 4,500 ft
3. 6,000 ft
4. The category II aircraft must have taxiied off the landing runway

11-6. Refer to figure 10-33 in your textbook. What separation must exist between an arriving category II aircraft and a departing category III aircraft at the time the category II aircraft crosses the landing threshold?
1. 1,000 ft
2. 3,000 ft
3. 4,500 ft
4. 6,000 ft

11-7. If reasonable assurance exists that the prescribed separation will be met when the next arriving aircraft crosses the landing threshold, you need NOT withhold landing clearance until the separation actually exists.

11-8. Navy pilots are required to "read back" all ATC clearances.

11-9. The pilot of multiengine aircraft departing on an IFR flight should be informed over the clearance delivery frequency of his departure control frequency.

11-10. Minimum separation between two category I aircraft taking off requires that the first aircraft be
1. 3,000 feet ahead of the second and airborne
2. 4,500 feet ahead of the second and airborne
3. 6,000 feet ahead of the second and airborne
4. 7,500 feet ahead of the second

11-11. When a category I aircraft departs behind a category III aircraft, the category III aircraft must be airborne and have travelled how many feet before the category I aircraft is cleared for takeoff?
1. 3,000
2. 4,500
3. 5,000
4. 6,000

11-12. Refer to figure 10-43 in your textbook. The departing aircraft may be cleared for takeoff when the arriving aircraft has met which of the following conditions?
1. Completed its landing roll and is holding short of the intersection
2. Completed its landing roll and is holding past the intersection
3. Taxied off the runway
4. All of the above

11-13. Controllers may initiate intersection takeoffs for all EXCEPT which of the following reasons?
1. For more efficient movement of traffic
2. The aircraft does not need the entire runway length
3. To reduce taxiing distances
4. To minimize departure delays

11-14. What is the proper separation between successive departing helicopters?
1. The preceding departure is clear of the helipad
2. The preceding departure is clear of the airport traffic pattern
3. The preceding departure has requested to change to en route frequency
4. The same separation used for departures from runways will be used for helicopter departures

11-15. To authorize simultaneous landings or takeoffs for helicopters, what is the minimum distance required between landing and takeoff points?
1. 150 ft
2. 200 ft
3. 300 ft
4. 400 ft

11-16. Control tower permission must be obtained by the pilot of a Navy helicopter to
1. exceed an altitude of 500 feet within the control zone only
2. cross a runway not in use only
3. cross the duty runway only
4. exceed an altitude of 500 feet within the control zone or cross the duty runway

11-17. Under what condition(s) may a helicopter pilot practice autorotations?
1. He remains within the boundaries of the airport
2. He operates over a surface safe for the maneuver
3. He remains accessible to crash and firefighting equipment
4. All of the above

● In items 11-18 and 11-19, assume that an airport is equipped with parallel runways on which same-direction landings and takeoffs may be performed. VFR conditions exist and two-way voice radio is maintained.

11-18. Refer to table 10-2 in your textbook. Two C-130s may be cleared to land simultaneously providing the runway centerlines are at least
1. 400 ft apart
2. 600 ft apart
3. 700 ft apart
4. 850 ft apart

11-19. Refer to table 10-3 in your textbook. Simultaneous opposite-direction operations may be authorized for individual aircraft of a squadron of F-4s at night if the runway centerlines are a minimum of 2,800 feet apart.

11-20. When an aircraft towing a target is in or near the traffic pattern, the primary interest that an AC has in tow target operations is to see that flight safety is maintained.

11-21. Instructions for which of the following operations are given by the landing signal officer (LSO) to the pilot of an aircraft conducting field carrier landing practice (FCLP)?
1. Landing
2. Taxiing
3. Initial takeoff
4. All of the above

11-22. Which of the following types of lights are used at night to simulate flight deck boundaries on a runway for practicing FCLP landings?
1. Runway lights
2. Portable lights
3. Smudge pots
4. Either 2 or 3 above, as appropriate

<u>IFR/SVFR Control Procedures</u>

Text: Pages 11-1 through 11-27

Learning Objective: Recognize control procedures specified for IFR traffic control.

11-23. Which of the following contributions did military technology make in providing the best possible navigation aids for use within national airspace?
1. IFF
2. Radar
3. TACAN
4. All of the above

11-24. IFR ATC service is provided within all EXCEPT which of the following areas?
1. Federal airways and jet routes
2. Control areas and transition areas
3. Control zones and the continental control area
4. Noncontrolled airspace

11-25. The procedures and minima contained in a letter of agreement or other appropriate military document CANNOT be less than those specified in the Terminal Air Traffic Control Handbook 7110.65 (Series) unless the appropriate military authority permits special procedures which
1. reduce the separation between military aircraft
2. reduce the separation between all aircraft, civil and military
3. exclude all military aircraft
4. permit civil aircraft to fly through the area

11-26. Which of the following procedures does NOT require a letter of agreement between your air station and the FAA?
1. Ground Controlled Approach (GCA)
2. Approach control
3. Control tower
4. Landline communication

11-27. A pilot may cancel his IFR flight plan and thereby obtain landing clearance priority over all other VFR aircraft.

11-28. Transfer of control responsibility to another controller or facility can only be effected at a specified fix, time, or altitude. Additionally, transfer can be effected after any potential conflict with other aircraft being transferred and other aircraft under the jurisdiction of the receiving controller has been eliminated.

11-29. Formation flights operating IFR within the national airspace system are normally treated as
1. VFR aircraft
2. a single aircraft
3. a single aircraft or a group of aircraft, depending on the capability of ATC to provide the service
4. a group of aircraft, with the size determined by the number of aircraft involved

11-30. If a non-ATC facility relays a clearance issued by an ATC facility, it must relay the message word-for-word and prefix the message with the phrase "ATC clears."

11-31. At 1300, IFR flight Navy 123 reported over Olathe. The last altimeter setting Kansas City ARTCC had received from Olathe weather service was at 1155 and was issued to the pilot as follows.

NAVY ONE TWO THREE ALTIMETER
TWO NINER NINER TWO

Why is this report in error?
1. Because the setting was not currently obtained from ARTCC's altimeter setting
2. Because the time of the setting was not given
3. Because the source of the setting was not given
4. Both 2 and 3 above

11-32. Upon initial radio contact with a descending aircraft, controllers are required to verify the passing altitude even though a new altitude will be assigned.

11-33. A position report has NOT been received from Navy 65432, an A-4 westbound at FL 270 which was due over Podunk intersection at 1300. ARTCC is dependent upon this report to effect separation between other traffic. The center should attempt to obtain this report no later than what time?
1. 1255
2. 1300
3. 1305
4. 1310

11-34. At 1340, an F-14 on an IFR flight plan was delivered an Expected Further Clearance (EFC) time of 1500. The aircraft has NOT been heard from since, and the time is now 1510. Other IFR traffic must be restricted and/or suspended until
1. 1510
2. 1530
3. 1545
4. 1600

11-35. Unless broadcast via ATIS and received by the pilot, specific items of approach control information which should normally be issued to aircraft upon initial contact include
1. approach clearance, weather, runway condition, and type of approach
2. approach clearance, runway, surface wind, altimeter setting, ceiling, and visibility if below basic VFR
3. approach clearance, runway conditions, surface wind, and time check
4. approach clearance, weather, surface wind, and runway dimensions

11-36. Before a pilot can fly within controlled airspace under the instrument flight rules of FAR 91, he must NOT only file an IFR flight plan but must also obtain an ATC clearance.

Learning Objective: Given selected problems involving IFR air traffic separation, determine the minimum applicable separation.

11-37. If an aircraft is flying IFR at FL 290, two additional aircraft may fly IFR in the same area with minimum vertical separation if they are at which of the following FLs?
1. 270 and 300
2. 280 and 300
3. 280 and 310
4. 300 and 310

11-38. A pilot reports severe turbulence while operating IFR at FL 180. He requests and is issued clearance to climb to and maintain FL 200. Another aircraft may NOT be assigned to FL 180 until the first pilot makes which of the following reports?
1. Leaving FL 180
2. Passing through FL 185
3. Passing through FL 190
4. Approaching FL 200

11-39. Two IFR aircraft take off from adjacent airports and intend to follow the same course and altitude. If the first aircraft is flying at 340 knots and the second at 290 knots, they must be longitudinally separated by at least how many minutes?
1. 1
2. 5
3. 3
4. 10

11-40. An IFR aircraft has taken off from the Kansas City airport and is flying at 200 knots on the same course and altitude as an en route IFR aircraft flying at 250 knots and which has previously reported over the Kansas City fix. With DME operable on both aircraft, the longitudinal distance between them must be at least how many miles?
1. 1
2. 5
3. 3
4. 10

11-41. If IFR aircraft A has taken off an is flying at 325 knots and IFR aircraft B takes off from the same airport and flies the same route and altitude at 300 knots, the longitudinal separation between them must be at least how many minutes?
1. 1
2. 2
3. 3
4. 5

11-42. What is the minimum longitudinal separation that must be maintained between two en route aircraft that are flying at the same altitude on the same course if the leading aircraft is flying at 300 knots and the trailing aircraft at 250 knots and both have reported over the same fix?
1. 15 min
2. 10 min
3. 3 min
4. 5 min

11-43. If the pilots of two IFR aircraft on the same course and altitude agree to keep longitudinal separation, they may be authorized to maintain a time lapse of 10 minutes or a distance of 20 miles between their aircraft if they communicate directly with one another.

11-44. IFR aircraft A, using DME, obtained distance information from a station having a DME NAVAID. IFR aircraft B, NOT equipped with DME, reports over the same station at the same altitude as aircraft A. The minimum longitudinal separation between A and B must be
1. 30 mi
2. 20 mi
3. 10 mi
4. 5 mi

11-45. The airspace to be protected when applying airway or route-type lateral separation is determined by reference to the description of airways or routes in publication FAR 71.5.

11-46. Off established airways, how wide is the protected airspace a pilot flying at 10,000 feet will have to maneuver in if he makes a course change of less than 15 degrees 130 miles from a NAVAID?
1. 20 mi
2. 10 mi
3. 8 mi
4. 4 mi

11-47. On routes other than established routes where a course change of more than 15 degrees but less than 91 degrees is made, the lateral route and airway separation to be provided on the overflown side at FL 500 is
1. 9 mi
2. 10 mi
3. 17 mi
4. 22 mi

11-48. What is the minimum lateral DME separation between the arc of a navigational aid and the boundary of a holding pattern airspace area located 35 miles from the NAVAID?
1. 15 mi
2. 10 mi
3. 3 mi
4. 5 mi

11-49. Assume that two IFR aircraft, A and B, are both using DME, and they are both flying the same course from the same fix. Aircraft A is preceding B, and A is flying at 5,000 feet and B at 3,000 feet. If B is to climb to 7,000 feet, what minimum separation must be met when B reaches 5,000 feet?
1. 5 mi
2. 10 mi
3. 15 mi
4. 20 mi

11-50. IFR aircraft B reports over a fix flying at 7,000 feet behind IFR aircraft A which had previously reported over the same fix flying at 9,000 feet. If aircraft B climbs to 11,000 feet within 10 minutes after reporting, what should be the minimum longitudinal separation between them?
1. 1 min
2. 5 min
3. 3 min
4. 10 min

11-51. What is the minimum longitudinal separation that is required when a leading IFR aircraft is flying at 280 knots and a trailing IFR aircraft is flying at the same altitude at 260 knots if both aircraft are equipped with DME?
1. 5 mi
2. 10 mi
3. 15 mi
4. 20 mi

11-52. If two opposite direction IFR aircraft are separated by minimum vertical separation, this minimum must be maintained for how long longitudinally if they request a conflicting altitude change?
1. 15 minutes before and after their estimated time to pass
2. 10 minutes before and after their estimated time to pass
3. 3 minutes before their estimated time to pass
4. 5 minutes before their estimated time to pass

11-53. IFR aircraft A has just taken off and immediately turns 45 degrees away from the course to be followed by IFR aircraft B which is ready for takeoff on the same runway. The controller may clear aircraft B for takeoff after the time lapse of
1. 1 min
2. 2 min
3. 3 min
4. 1/2 min

11-54. If the pilots of two similar aircraft propose to fly the same course immediately after takeoff and then fly divergent courses 45 degrees or more apart within 5 minutes, action must be taken to ensure that a separation minimum of how many minutes be maintained during the period they are following the same course?
1. 1
2. 2
3. 3
4. 4

11-55. Which of the following statements is applicable to two aircraft taking off in the same direction from parallel runways whose centerlines are 3,600 feet apart if the aircraft are to fly 45-degree divergent courses immediately after takeoff?
1. They must be separated by at least 1 minute
2. They must be separated by at least 3 1/2 minutes
3. They may take off simultaneously
4. They must be separated by the length of the runway used by the first aircraft

11-56. Simultaneous takeoffs of two aircraft that are to fly 45-degree divergent courses are permitted from runways that diverge by 24 degrees if the distance between the runway centerlines at and beyond the point where the takeoffs begin is at least how many feet?
1. 1,500
2. 2,000
3. 2,500
4. 3,500

11-57. Two DME-equipped aircraft take off from the same runway and are flying on the same course. If the succeeding aircraft will climb through the preceding aircraft's altitude, the aircraft must be separated by what minimum distance until the succeeding aircraft passes through the preceding aircraft's altitude?
1. 12 mi
2. 2 mi
3. 5 mi
4. 4 mi

11-58. When approach control service is provided, a departing aircraft can be cleared for takeoff on a heading that differs by at least 45 degrees from the reciprocal course of an arriving aircraft making an instrument approach any time before the arriving aircraft leaves a fix inbound that is NOT less than what distance from the airport?
1. 10 mi
2. 5 mi
3. 3 mi
4. 4 mi

11-59. At a nonapproach control facility, an IFR flight may take off in a direction that differs by at least 45 degrees from the reciprocal of the final approach course. The departing aircraft must take off 3 minutes before the arriving aircraft is estimated at the airport.

11-60. Assume that aircraft A is making a straight-in instrument approach on a heading of 090 degrees and is estimated to arrive at the airport at 1000. Aircraft B is ready to takeoff from runway 24 and turn left to fly a course of 210 degrees. Aircraft B may be cleared for departure provided it can be established on the course of 210 degrees by
1. 0955
2. 0956
3. 0957
4. 0958

Learning Objective: Identify special VFR and other related procedures.

11-61. Under which of the following conditions may a tower controller provide/authorize visual separation within the control zone?
1. The tower controller sees two arriving aircraft and says he will provide separation
2. The pilot sees the other aircraft and says he will maintain visual separation from it
3. The tower controller sees an arriving aircraft and will visually separate a departing aircraft from it
4. All of the above

11-62. At 2100 local time a pilot requested a VFR on-top clearance while in a holding pattern with several other aircraft. His request was denied for which of the following reasons?
1. The pilot was trying to avoid delay by coming in before his turn
2. ATC was not disposed to grant it
3. There was no report available on the tops of the clouds
4. VFR on-top clearance may not be issued to separate holding aircraft at night

11-63. An aircraft operating in positive controlled airspace may be granted a VFR or VFR-conditions-on-top type of clearance any time the weather conditions are suitable.

11-64. A SVFR clearance to climb to VFR may be authorized if the only weather limitation is restricted visibility.

11-65. It is permissible for a controller to assign a fixed altitude to a special VFR aircraft.

11-66. Reported ground visibility at your airport is below one mile, and an arriving aircraft is operating in your control zone. What is the first action you should take?
1. Ask the pilot if he can depart the control zone with a flight visibility of 1 mile
2. Issue landing clearance
3. Deny landing clearance
4. Have the pilot remain in the control zone until flight visibility increases to 1 mile

11-67. What is the required separation between a departing FW/IFR aircraft and an SVFR helicopter when the FW/IFR aircraft is 1 mile from the end of the runway?

1. 1 mi
2. 2 mi
3. 1 1/2 mi
4. 2 1/2 mi

Assignment 12

Radar Principles and Allied Equipment

Text: Pages 12-1 through 12-30

Learning Objective: Identify functions of radar system components and types and uses of various displays.

12-1. What is the approximate speed that radio energy travels?
1. 162,000 nautical miles per second
2. 162,000 nautical miles per hour
3. 16,200 nautical miles per second
4. 16,200 nautical miles per hour

12-2. When the radiated electromagnetic waves strike an object, some of the energy is reflected to the transmitter site where it is amplified by the
1. transmitter
2. receiver
3. modulator
4. waveguide

12-3. A portion of a fixed CRT has a continuous lighted area during normal operation. What is the most likely cause?
1. There is no object in the path of the transmitted radar pulse
2. A stationary object is in the path of the transmitted radar pulse
3. It is due to a malfunction in the transmitter or one of its components
4. It is due either to a malfunction in the CRT or radio wave propagation

In items 12-4 through 12-6, select from column B the function of each basic radar transmitting system component listed in column A.

	A. Components	B. Functions
12-4.	Synchronizer	1. Converts the d.c. pulses received from the modulator into extremely high frequency radio energy
12-5.	Transmitter	2. Acts as an electronic switch or valve to furnish high a.c. voltage to the transmitter in brief pulses
12-6.	Antenna	3. Rotates and shapes the RF energy into the desired beam
		4. Furnishes a sharp, low pulse to trigger the modulator and the sweep generator simultaneously

In items 12-7 through 12-9, select from column B the basic radar receiving system component that performs each function listed in column A.

	A. Functions	B. Components
12-7.	Converts the RF pulses into sharp video pulses	1. Sweep generator
12-8.	Converts the video pulses received from the video amplifier into light indications	2. Indicator
12-9.	Receives the echo energy from the reflector and transmits it through the duplexer to the receiver	3. Receiver
		4. Antenna

- Items 12-10 and 12-11 refer to radar displays.

12-10. The type of radar display used in air traffic control depends on the
1. location of the time reference on the scope face
2. spacing of the rangemarkers on the scope face
3. use to be made of the radar data
4. distance to be covered

12-11. What type of radar display can you use to increase the maximum range of coverage on a scope face for a selected azimuth sector?
1. Moving target indicator (MTI)
2. Plan position indicator (PPI)
3. Identification friend or foe (IFF)
4. Offcenter plan position indicator

12-12. The precision radar indicator is commonly called the AZ-EL indicator.

12-13. Which of the following dangers presents a potential hazard to the operator and maintenance personnel when they are working around radar?
1. Electrocution
2. Sterilization
3. Implosion
4. All of the above

Learning Objective: Identify capabilities, characteristics, and utilization of auxiliary radar equipment, including the moving target indicator, circular polarization, and surveillance application.

12-14. What is the primary purpose of the automatic frequency control (AFC) circuit?
1. To reduce the number of radar echo signals
2. To increase the number of radar echo signals
3. To prevent frequency drift of the radar transmitter and receiver
4. To make sure the radar transmitter and receiver are tuned to the same frequency

12-15. What auxiliary component of a radar system eliminates stationary targets (clutter) from the basic display?
1. Automatic volume control (AVC)
2. Moving target indicator (MTI)
3. Automatic frequency control (AFC)
4. Plan position indicator (PPI)

12-16. The ability of MTI to display any specific aircraft target depends on the radial velocity of the aircraft. Radial velocity is the speed an aircraft flies toward or away from the radar antenna.

12-17. Which of the following radar presentations may be selected by an AC who operates a radar system with both normal and MTI?
1. A normal display utilizing signals from both moving and stationary targets
2. A display in which the MTI signals are range-gated at a desired range with normal signals beyond
3. An MTI display showing only moving targets
4. All of the above

12-18. During heavy thunderstorms, you should select linear polarization to prevent the targets from being obscured on the radar scope.

- Items 12-19 through 12-23 refer to the mapping systems.

12-19. What information does a controller observe from a PPI display by using the rangemarks on the scope and the compass rose?
1. Altitude and azimuth
2. Azimuth and range
3. Range and geographical location
4. Altitude and geographical location

12-20. Which of the following statements about a map overlay is INCORRECT?
1. It is made of transparent plastic
2. It provides the necessary reference marks and the location of NAVAIDs
3. It is mounted directly on the CRT
4. Obstructions and runways are etched into its surface

12-21. What inherent disadvantage of the map overlay must you be careful to avoid when observing a target?
1. Parallax
2. Clutter
3. Polarization
4. Radiation

12-22. The video map's biggest advantage over the map overlay is that the video map expands and contracts as the range on the scope is changed.

12-23. Which of the following conditions affecting a radar display of video mapping is likely to be listed as a disadvantage of a video mapping system?
1. The map is good for only one range setting
2. The targets may not appear in proper relation to the map
3. The radar information is not presented with map data
4. The mapping unit is subject to failure

12-24. Which of the following factors determines the degree and length of target fades when aircraft pass directly over the antenna site?
1. Atmospheric conditions
2. Surrounding terrain
3. Antenna height
4. Tilt angle of the antenna

12-25. What action should be taken if a previously unknown fade area is suspected after a radar facility has been commissioned?
1. The equipment capabilities must be studied
2. Another flight check must be requested
3. The flight data must be reviewed
4. The height of the antenna must be increased

12-26. Anomalous propagation is the bending of a radar beam as it passes through the atmosphere, and it is most likely to occur over areas where there is a difference between air and surface temperature.

12-27. An AC who observes apparent radar targets traveling at tremendous speeds and frequently changing directions would probably be correct in assuming that they are the results of temperature inversions.

12-28. Large areas of clutter appearing on a radarscope as a result of passive radar jamming are produced by
1. standby channel interference
2. thin metal strips
3. generated radar energy
4. dual channel interference

12-29. If a nearby radar installation which is operating on a similar frequency interferes with proper operation of your radar system, you should request that installation to
1. retune its standby channel
2. relay its log of false targets to you
3. realign its modulator
4. check its frequency calibration

12-30. A controller can relay accurate information to a pilot concerning the heading of the pilots aircraft by using information provided by the surveillance radar.

12-31. The surveillance radar operator should inform the pilot of which of the followin factors so that the pilot can maintain the proper glide angle during a surveillance final approach?
1. Azimuth only
2. Range only
3. Range and desired altitude
4. Altitude and azimuth

Learning Objective: Recognize the capabilities, limitations, and associated equipment of the Air Traffic Radar Beacon System (ATCRBS) and its application as an invaluable tool.

12-32. Which of the following types of radar can be operated independently but also can be used with surveillance radar in the control of air traffic?
1. RACON
2. Secondary surveillance
3. Primary
4. Both 2 and 3 above

12-33. Which of the following groupings identifies the components of a secondary surveillance radar system?
1. An interrogator on the ground, a transponder in the aircraft, and a display on an air traffic control radarscope
2. An interrogator in the aircraft, a transponder on the ground, and a display on an air traffic control radarscope
3. An interrogator on the ground, a transponder on the ground, and a display on an aircraft radarscope
4. An interrogator in the aircraft, a transponder in the aircraft, and a display on an air traffic control radarscope

12-34. The difference between secondary surveillance radar and primary radar is that in secondary surveillance radar the signals displayed are transmitted by a transponde in the aircraft rather than being reflected by the aircraft.

● Items 12-35 through 12-39 refer to the basic radar beacon system.

12-35. What is the transmission characteristic of the interrogation signals of a radar beacon system?
1. The paired pulses are spaced the same for all modes
2. The paired pulses are spaced according to the interrogation mode in use
3. The paired pulses are spaced at random
4. The paired pulses are spaced the same as the primary radar pulses

12-36. What sequence of events and antenna arrangement will provide the AC with a display of correlated information simultaneously from beacon and radar systems?
1. The radar pulse must be transmitted at a preset time before the beacon pulse pair, and each system's antenna must be mounted on a separate pedestal
2. The radar pulse must be transmitted at a preset time before the beacon pulse pair, and both systems' antennas must be mounted on a common pedestal
3. The beacon pulse pair must be transmitted at a preset time, and each system's antenna must be mounted on a separate pedestal
4. The beacon pulse pair must be transmitted at a preset time before the radar pulse, and both systems' antennas must be mounted on a common pedestal

12-37. In what component of the ground equipment system will the beacon video signals be processed when the transponder in an aircraft responds to a challenge by an I/R unit?
1. Video mixer
2. Decoder
3. Interrogator
4. Receiver

12-38. Before the transmitter of a radar transponder will transmit a reply, the transponder must
1. receive primary pulses and process them into echoed pulses
2. receive, key, and process echoed radar pulses
3. receive and process special keyed pulses
4. receive echoed pulses and convert them into primary pulses

12-39. Which of the following statements about the transponder is INCORRECT?
1. The strength of the response is dependent upon the intensity of the interrogating signal received
2. Different frequencies are used for interrogation and reply
3. The interrogation signal is different from the reply signal which may be coded or uncoded
4. There is an inherent delay between the receipt and the reply to an interrogation

12-40. Which of the following ATCRBS modes have been designated "air traffic control modes"?
1. A and 3
2. B and 2
3. C and 3
4. D and 1

12-41. The two primary objectives of the AIMS program are to improve air traffic control through ATCRBS and to provide a military identification system that is
1. accurate
2. secure
3. versatile
4. improved

12-42. The interrogator equipment of the DAIR system can use existing PPI consoles.

12-43. In addition to the assigned beacon code that the aircraft is squawking, the AN/TXP-42 data block displayed adjacent to the aircraft's actual position consists of the aircraft's
1. route
2. destination
3. groundspeed
4. altitude

12-44. The remote control indicator should be located at or near the
1. master control unit
2. source of power
3. PPI console
4. control tower

12-45. When a controller sets the desired upper and lower limits on the control indicator, replies from only those aircraft within these limits are displayed on the AN/TPX-42, with the exception of aircraft which are having communications failure or which are
1. making a change of flight plan
2. experiencing an emergency
3. making a change in altitude
4. encountering IFR weather

12-46. The operator's control indicator is equipped with which of the following attention-getting devices?
1. A buzzer only
2. A red light only
3. A buzzer and a red light
4. A bell

Learning Objective: Identify the types, uses, and operating characteristics of ATC radar systems.

12-47. Surveillance radar in a GCA unit is displayed on what type of radarscope?
1. A
2. B
3. AZ-EL
4. PPI

12-48. The AN/CPN-4 is a self-contained, mobile radar unit used to control the approach of aircraft during reduced ceiling and visibility.

12-49. Which of the following statements about the AN/FPN-47 radar may be correct when the 200-mile range is selected?
1. Radar video only may be displayed for the first 60 miles of the sweep, and radar beacon video may be displayed from 60 to 200 miles
2. Radar beacon video only may be displayed for the first 60 miles of the sweep, and radar video may be displayed from 60 to 200 miles
3. Radar and radar beacon video may be displayed simultaneously for the first 60 miles of the sweep, and radar video only may be displayed from 60 to 200 miles
4. Radar and radar beacon video may be displayed simultaneously for the first 60 miles of the sweep, and radar beacon video only may be displayed from 60 to 200 miles

12-50. One of the advantages the ASR-8 has over the ASR-5 is a staggered PRF which prevents the occurrence of blind speeds caused by MTI.

12-51. The AZ-EL scope of the AN/FPN-52 radar provides which of the following information for use by an operator when controlling an aircraft on an instrument approach?
1. Centerline of the runway
2. Glidepath
3. Distance from touchdown
4. All of the above

12-52. At a point 1 mile from the approach end of the runway, the ASR approach course line must NOT exceed how many feet left or right from the runway centerline extended?
1. 100
2. 200
3. 300
4. 500

12-53. The 15G20 Simulator is designed to provide refresher, upgrade, and proficiency training for ACs and can provide up to 40 primary and 20 secondary simulated radar targets plus communications.

Assignment 13

Radar Operations

Text: Pages 13-1 through 13-26

Learning Objective: Identify qualifications and responsibilities of air traffic controllers, and recognize procedures and regulations that must be followed in directing aircraft including terminal radar services and pilot procedures.

13-1. The IFR control room of a naval ATC facility should be located in
1. the control tower
2. a trailer near the GCA trailer
3. the operations building
4. a trailer near the touchdown end on the instrument runway

13-2. The mission of a Navy ATC facility is to provide safe, orderly, and expeditious movement of air traffic in which of the following areas?
1. Into and from the national airspace system
2. Within the facility's area of control
3. To and from operating areas
4. *All of the above*

13-3. Which of the following statements reflects the policy that is strongly recommended in OPNAV Instruction 3721.1 (Series) in reference to competent controllers?
1. They must possess a general knowledge of the precision approach controller position only
2. They must possess a general knowledge of the duties of all operating positions
3. They must possess a general knowledge of their operating positions only
4. They must possess a detailed knowledge of all operating positions

13-4. What action is directed by OPNAV Instruction 3721.1 (Series) when a controller becomes properly qualified to control instrument traffic?
1. The commanding officer must make a suitable entry in the controller's service record
2. The controller must make the required entries in his service record
3. The commanding officer must enclose a letter of commendation in the controller's service record
4. The controller must make sure his service record has the required entries

13-5. A radar supervisor must be qualified and certified in all positions of the facility, and he is responsible to the facility watch supervisor for the operational efficiency of the watch team.

13-6. All EXCEPT which of the following duties is considered general duties of an approach controller?
1. Determining the time to be used between successive approaches by considering all aspects of air traffic control situations at the time
2. Controlling and coordinating the movement of all instrument traffic within the ATC facility's area of responsibility
3. Collecting, calculating, and posting flight data
4. Issuing air traffic clearances and information to aircraft under jurisdiction of approach control

13-7. The duties of the departure control position in an ATC facility may be combined with those of another position.

13-8. What information must the final controller provide a pilot to assist him in maintaining the correct approach path to the designated instrument runway?
1. Azimuth
2. Range
3. Elevation data
4. All of the above

13-9. When a radar controller assumes responsibility for a control position, he should check the radar alignment so that he can be personally satisfied that the radar presentation and equipment performance are adequate for the service to be provided.

13-10. When radar mapping is NOT available, a radar controller is limited to providing which of the following services?
1. Separating identified aircraft targets
2. Vectoring aircraft to intercept the final approach course
3. Ensuring there is no conflict with traffic on airways
4. All of the above

13-11. When the turn method is used to establish radar identification, the aircraft must be observed making a turn or turns of
1. 15° or more
2. 20° or more
3. 30° or more
4. 45° or more

13-12. You may establish secondary radar identification of an aircraft by directing the pilot to activate the IDENT feature of the transponder and then observing the
1. identification display
2. target display changes
3. appearance of the radar beacon
4. disappearance of the radar beacon

13-13. The pilot of an aircraft must be advised of his position if radar identification is established by means of
1. position correlation
2. identifying turns only
3. radar beacon procedures only
4. identifying turns or radar beacon procedures

13-14. A pilot must be informed of which of the following conditions?
1. Radar identification of his aircraft is initially established
2. Radar contact with his aircraft is lost
3. Radar identification is reestablished after radar contact was lost or radar service was terminated
4. All of the above

13-15. A minimum usable target is a target where the return is not missed on more than how many consecutive scans?
1. 5
2. 2
3. 3
4. 4

13-16. When, if ever, may you vector an aircraft which is outside of controlled airspace?
1. When the pilot makes a direct request for the vector
2. When you suggest the vector and the pilot concurs
3. When used for the purpose of avoiding other traffic
4. Never

13-17. What vector method is being used when the controller informs the pilot to TURN THIRTY DEGREES LEFT/RIGHT?
1. The direction of turn and the magnetic heading to be flown after the completion of the turn
2. The number of degrees to turn and the direction of turn, in group form
3. The magnetic heading to be flown
4. The type of vector and manner in which turns are to be made

13-18. What should you tell the pilot if you intend to vector him across the NAVAID final approach course?
1. Fly heading zero six zero for pattern correction
2. Expect vector across final approach course
3. Expect vector across final approach course for spacing
4. Fly present heading

13-19. A controller may effect a radar handoff to another controller by
1. informing the receiving controller that radar contact has been established
2. requesting the receiving controller to change to his frequency
3. asking the receiving controller to acknowledge the fix for the target
4. physically pointing out the target to the receiving controller

13-20. Communications and responsibility for control of an aircraft to be handed off using radar can be transferred to a receiving controller before the aircraft enters his area of responsibility.

13-21. If the ceiling at the airport of intended landing is below the highest circling minimum, it should be issued to the pilot in the approach information. When may the controller omit issuing ceiling information to the pilot?
1. When it is contained in current ATIS broadcast only
2. When the aircraft is on a VFR flight plan
3. When the aircraft is being assigned a precision approach
4. When this information is contained in the current ATIS broadcast and the pilot states the appropriate ATIS code

13-22. When an aircraft has been radar-identified and is being vectored to the final approach course, the controller must, as soon as practical, inform the pilot of the procedure to follow if radio communications are lost for a specified period of time NOT to exceed 1 minute.

13-23. If a pilot states he cannot accept a lost communications procedure, what action should the controller take?
1. Issue another approach procedure
2. Request the pilot to state his intentions
3. Issue another lost communication procedure
4. Instruct the aircraft to hold until weather conditions improve

13-24. If a delay is anticipated for an arriving aircraft and the holding pattern is charted, what additional holding information needs to be given?
1. The direction the pilot is to hold
2. The expected approach clearance time
3. The direction of holding and an EFC
4. The radial, course, bearing, and airway or jet route

13-25. When should holding pattern instructions specify the direction of holding pattern turns?
1. When left turns are to be made
2. When right turns are to be made
3. When holding will be accomplished on a DME fix
4. At all times

Learning Objective: Identify IFR separation minima and related procedures.

13-26. Radar separation may be provided IFR aircraft under various situations. One such case is between a departing aircraft and an identified IFR aircraft providing the aircraft taking off will be
1. tracked visually from the end of the runway for 1 mile
2. identified within 1 mile from the runway's end
3. identified within the last 1/2 mile of the runway
4. identified within 1/4 mile after takeoff

13-27. A radar-identified IFR aircraft cannot be cleared through the altitude of an unidentified IFR aircraft using radar separation only.

13-28. When you are applying radar separation, which of the following portions of beacon control slashes and/or primary targets is/are used to measure distance?
1. The ends of beacon control slashes
2. The end of a beacon control slash and the center of a primary target
3. The centers of primary targets
4. All of the above

13-29. If beacon range accuracy cannot be verified, the use of beacon targets is restricted to which of the following radar services?
1. Traffic information
2. Vectoring
3. Separation
4. Full air traffic control services

13-30. What is minimum radar separation between two aircraft under radar control if both of them are within 40 miles of the radar antenna site?
1. 3 min
2. 5 min
3. 3 mi
4. 5 mi

13-31. What minimum lateral distance must radar-controlled aircraft be separated from the boundary of an adjoining radar-controlled airspace that is more than 40 miles from the radar antenna site?
1. 1 1/2 mi
2. 2 1/2 mi
3. 3 mi
4. 5 mi

13-32. When you are applying radar separation between a radar controlled aircraft that is climbing through the altitude of another aircraft that has been tracked to the edge of the scope, you must keep the climbing aircraft at least 3 miles from the edge of the scope until nonradar separation has been established.

13-33. When a radar-controlled aircraft is within 40 miles of the antenna site, it may be separated from prominent obstructions displayed on the radarscope by a minimum of how many miles?
1. 10
2. 6
3. 3
4. 5

13-34. When will you advise the pilot APPROACHING GLIDEPATH?
1. On initial contact
2. Only upon pilot's request
3. One minute before intercepting glidepath
4 Approximately 10 to 30 seconds before final descent

13-35. When an aircraft reaches the point where final descent is to start, you should instruct the pilot to
1. begin descent
2. descend in 1 mile
3. prepare to begin descent
4. begin descent at pilot's discretion

13-36. Under which of the following conditions must you advise a radar controlled aircraft to EXECUTE A MISSED APPROACH?
1. Safety limits are exceeded
2. The position or identification of the aircraft is in doubt
3. Radar contact is lost
4. All of the above

13-37. When do you provide recommended altitude information to an aircraft on a surveillance approach?
1. When requested by the pilot
2. When the pilot is not instrument qualified
3. When the approach is being conducted in IFR weather
4. This information is provided for all approaches unless the pilot specifically requests its omission

13-38. Arriving aircraft may be vectored to the VFR traffic pattern and cleared for a visual approach if the reported ceiling is at least 500 feet above the minimum vectoring altitude and the visibility is at least 3 miles.

13-39. You may vector an aircraft to the VFR traffic pattern and clear it for a visual approach if
1. the aircraft is above the minimum vectoring altitude
2. the reported ceiling/visibility is at or above VFR minimums
3. separation can be provided
4. flight following information is provided until tower advises "landing assured"

13-40. In addition to the turn, position correlation, and beacon methods of identification, a departure is considered radar identified if it is observed
1. within 1 mile of the takeoff end of the runway
2. not more than 2 miles from the airport
3. within 3 miles of the takeoff end of the runway
4. not more than 15 miles from the airport

13-41. If the airport is located 45 miles from the radar antenna, what is the minimum radar separation that may be applied between an arrival on final approach and a departure?
1. Two miles providing the separation will increase to three miles within one minute after takeoff
2. Two miles providing the separation will increase to five miles within one minute after takeoff
3. Two miles providing the separation will be increased by one mile within five minutes after takeoff
4. Two miles providing the separation will be increased by two miles within one minute after takeoff

13-42. Aircraft A may be cleared for takeoff from the instrument runway of an airport 45 miles from the antenna site of the controlling radar facility with a minimum of 2 miles separation from aircraft B on an instrument radar-controlled approach, provided the separation will increase to how many miles within 1 minute after takeoff?
1. 1
2. 3
3. 5
4. 10

In items 13-43 through 13-45, select from column B the distance between runway centerlines that is required for each simultaneous radar-controlled parallel runway operation listed in column A.

A. Parallel Runway Operations	B. Distances Required
13-43. A departing aircraft is taking off from one runway, and an arriving aircraft is approaching the other. The thresh-holds are even	1. 3,300 ft
13-44. An arriving aircraft is approaching the nearest runway, and a departing aircraft is taking off from the other. The threshholds are staggered by 500 feet	2. 3,400 ft
13-45. An arriving aircraft is approaching the farthest runway, and a departing aircraft is taking off from the other. The threshholds are staggered by 500 feet.	3. 3,500 ft
	4. 3,600 ft

13-46. When providing radar vectors to a departing aircraft, it must be vectored to maintain at least a 3-mile lateral separation from prominent obstructions shown on the radarscope when the takeoff path is 3 miles or more from the obstruction.

13-47. If an arriving aircraft deviates from its approach/missed approach to a parallel runway, and on the other parallel runway is an aircraft ready but NOT committed for takeoff, the departing aircraft will be held.

Learning Objective: Differentiate between the services provided through expanded radar programs and identify additional radar services.

13-48. When, if ever, is Navy aircraft participation mandatory in the expanded radar services program?
1. When Stage I services are available
2. When Stage II services are available
3. When Stage III services are available
4. Never

13-49. What stage service, if any, provides separation between ALL IFR and participating VFR aircraft?
1. Stage I
2. Stage II
3. Stage III
4. None

13-50. As a controller, you have complete discreation in determining if you can provide or continue to provide an additional radar service.

13-51. When must you inform a pilot that previously issued traffic is no longer a factor?
1. When the pilot advises he has the issued traffic in sight
2. When the pilot advises he does not have the issued traffic in sight
3. Only when providing traffic information to pilots on VFR flight plans
4. Only when providing traffic information to pilots on IFR flight plans

13-52. To the extent possible, you should give priority to providing which of the following additional services?
1. Traffic information
2. Weather and chaff information
3. Bird activity information
4. Merging target information

13-53. When an unidentified aircraft is observed on the PAR display at the same altitude as the aircraft you are controlling on final, what action should you take?
1. Immediately issue an alert and offer the pilot an alternate course of action
2. Make a blanket broadcast on the emergency frequencies to the unidentified aircraft
3. Take no action, since it is obviously a VFR aircraft
4. Instruct the pilot of the aircraft you are controlling to execute a missed approach in the direction of the unidentified aircraft

13-54. If a pilot of an aircraft about to encounter IFR weather conditions on a VFR flight plan requests radar assistance, what should be your initial response?
1. Initiate a hazard report on the pilot
2. Ask if the pilot is qualified for and capable of conducting IFR flight
3. Advise the pilot to establish a holding fix until radar identification can be established
4. Request the pilot to give you the number of personnel on board, amount of fuel, and number of hours he has flown

13-55. Which of the following techniques should be used when providing radar assistance to a pilot NOT qualified to fly in IFR conditions?
1. Avoid radio-frequency changes, except as necessary, to provide a clear communications channel
2. Advise the pilot to lower the landing gear and slow the aircraft to approach speed
3. Request the pilot to turn and descend at the same time
4. Vector the aircraft to VFR conditions

13-56. You are controlling VV57199 and suddenly the transponder code changes to 7500. Using proper phraseology, you ask the pilot if he is transmitting this code intentionally and the pilot fails to respond. What action do you take?
1. Check your receiver for a malfunction
2. Check your beacon equipment for a malfunction
3. Repeat the transmission over and over until the pilot responds
4. Make no other request but be responsive to any request made by the pilot

13-57. While working the approach position, you observe a beacon target change to code 7700 for one minute and then to code 7600 for an extended period of time. What does this tell you about the aircraft?
1. The aircraft is experiencing radio difficulty as well as an additional emergency situation
2. The aircraft is experiencing loss of two-way radio capability
3. The pilot is completing his pre-departure checklist
4. The aircraft is being unlawfully interfered with

Assignment 14

Carrier Air Traffic Control Procedures

Text: Pages 14-1 through 14-32

Learning Objective: Recognize the responsibilities and general operating procedures of the Carrier Air Traffic Control Center (CATCC) during carrier operations and be able to differentiate between CATCC and LPH procedures.

14-1. Status keeping of all carrier air operations is the responsibility of the
1. air officer
2. CIC officer
3. operations officer
4. landing signal officer

In items 14-2 through 14-4, select from column B the CATCC term identified by each definition listed in column A.

	A. Definitions	B. CATCC Terms
14-2.	An order to an aircraft to proceed immediately to a divert field	1. Coupled
		2. Inbound bearing
14-3.	Aircraft automatic flight control system engaged and linked to data link command	3. Bingo
		4. CCA
14-4.	Carrier Controlled Approach	

In items 14-5 through 14-7, select from column B the definition of each CATCC term in column A.

	A. CATCC Terms	B. Definitions
14-5.	Charlie	1. A report from a pilot indicating that the flight is ready to proceed on its mission
14-6.	Clara	
14-7.	Kilo	2. A signal for aircraft to land
		3. A collective radio call prefixed by the ship's code name
		4. A report from a pilot that he does not have the meatball in sight

14-8. A desirable method of indoctrinating personnel in all phases of the center's tasks is to
1. ensure that they are not rotated between the two major branches
2. ensure that they are rotated within and between the two major branches
3. train each person to become specialized in one position
4. limit each person's specialization to not more than two positions

14-9. What is the mission of air operations?
1. To coordinate the carrier's search and rescue operations
2. To furnish pertinent flight information to pilots
3. Scheduling and coordinating the carrier's flight operations
4. Both 2 and 3 above

14-10. Information concerning the fuel state of an aircraft is relayed to and recorded by the
1. radio operator
2. teletype operator
3. status board keeper
4. land/launch recordkeeper

14-11. Who maintains the accuracy of the navigational information posted on the status board?
1. DRT operator
2. Teletype operator
3. Sound-powered telephone talker
4. Land/launch recordkeeper

14-12. How many approach controllers are normally used during a CCA recovery?
1. 1
2. 2
3. 3
4. 4

14-13. The CCA departure controller performs which of the following functions?
1. Requests NAVAID checks as necessary
2. Maintains advisory control of departing point-to-point flights until pilots shift to en route frequencies
3. Transfers control of departing flights to CIC and ensures that CIC acknowledges assumption of control
4. All of the above

14-14. What CCA controller provides inbound flights with information concerning the type of approach and final bearing before commencing an approach?
1. The approach controller
2. The final controller
3. The marshal controller
4. The bolter waveoff controller

14-15. When is positive control of an inbound aircraft assumed by the final controller?
1. When radio contact is established
2. When radar contact is established
3. When visual contact is established
4. Both 2 and 3 above

14-16. If radar contact has been established, at what distance from the ramp will a CCA final controller normally assume positive control of an aircraft?
1. 4 to 6 mi
2. 7 to 9 mi
3. 10 to 12 mi
4. 13 to 15 mi

14-17. Preparation and distribution of the daily air plan is the responsibility of the
1. precision approach controller
2. surveillance controller
3. air operations officer
4. operations officer

14-18. CATCC should be manned for what period of time before scheduled flight operations?
1. 1/2 hr
2. 1 hr
3. 1 1/2 hr
4. 2 hr

14-19. The CATCC brief serves what purpose?
1. It informs the other ships in company of the carriers intentions
2. It updates the daily air plan
3. It serves as the Carrier Terminal Information Service on carriers where CTIS is not available
4. It ensures that the flight crews are provided sufficient information to complete the assigned mission

14-20. Which of the following flight operations does NOT require a flight plan or flight advisory?
1. Cyclic operations outside ADIZ boundaries wherein the aircraft will not fly over land or penetrate the ADIZ
2. Flights that will terminate ashore
3. Flights that will penetrate controlled airspace
4. Flights within ADIZ boundaries

14-21. Except for the nighttime requirement for Case III procedures, the degree of control necessary for CV flight operations is determined by the
1. air officer
2. operations officer
3. air operations officer
4. carrier controlled approach officer

14-22. What type of control is used by CATCC when flight operations are conducted between 1/2 hour after sunset and 1/2 hour before sunrise?
1. Radar
2. Close
3. Monitor
4. Advisory

14-23. The degree of control exercised by CATCC using electronic techniques to monitor radar and radio contacts and to provide advisories is described as
1. monitor control
2. advisory control
3. close control
4. flight following

14-24. Aircraft under nonradar control in IMC should be separated by at least how many minutes or miles?
1. 1 min
2. 2 min
3. 3 mi
4. 5 mi

14-25. When turboprop aircraft are below FL 290 and within 10 miles of the carrier, you may reduce vertical separation to how many feet?
1. 300
2. 500
3. 800
4. 1000

14-26. What is the minimum standard separation for departing aircraft using TACAN radials in IMC?
1. 10°
2. 15°
3. 20°
4. 30°

14-27. When should transient helicopters that are approaching the CV contact the center?
1. Prior to entering the carrier control area
2. At least 25 miles out
3. At least 50 miles out
4. Prior to entering the carrier control zone

14-28. The term "marshal fix" of a CV instrument approach procedure in comparison to a similar fix of an instrument approach ashore is synonymous with what fix?
1. Approach
2. Final approach
3. Initial approach
4. Intermediate approach

14-29. For CV instrument approach procedures, the primary TACAN marshal fix for jet aircraft to hold at 20,000 feet would be established as the
1. 30-mile DME fix on the radial which is 125° relative to the expected FB
2. 30-mile DME fix on the 180° radial
3. 41-mile DME fix on the radial which is 180° relative to the expected FB
4. 41-mile DME fix on the radial which is 225° relative to the expected FB

14-30. What is the lowest altitude that may be assigned to jet aircraft in marshall?
1. 3,000 ft
2 6,000 ft
3. 10,000 ft
4. 15,000 ft

14-31. Which of the following types of aircraft would you expect to find in a left-hand racetrack pattern at a TACAN holding fix?
1. Prop aircraft only
2. Helicopters
3. Prop and turboprop aircraft
4. Jet and turboprop aircraft

14-32. The TACAN marshal fix for prop aircraft is located on what radial relative to the expected final bearing?
1. 150°
2. 180°
3. 225°
4. 270°

14-33. Which of the following examples correctly demonstrates the minimum distance and altitude that may be assigned to a prop aircraft for Emergency Marshal?
1. 10 miles at 2,500 feet
2. 15 miles at 1,000 feet
3. 17 miles at 2,000 feet
4. 17 miles at 5,000 feet

14-34. If instrument weather conditions exist at the assigned altitude or flight level, what is the maximum number of aircraft in formation that you may assign to one marshal altitude?
1. 1
2. 2
3. 3
4. 4

14-35. What type of recovery is appropriate when nighttime weather conditions are such that the flight may encounter IMC during descent, but visual conditions of at least 1,000 feet ceiling and 5 miles visibility exist at the ship?
1. Case III only
2. Case II or III only
3. Case II only
4. Case I, II, or III

14-36. Instrument approach weather minimums for procedures aboard CVs are established by the
1. Defense Mapping Agency Hydro Center
2. embarked CAW/CAG
3. appropriate fleet commander
4. ship's commanding officer

14-37. During a Case II recovery, under what circumstance should CATCC direct a flight into the bolter/waveoff pattern?
1. When the ship has not turned into the wind
2. When the flight does not have the ship in sight at 5 miles
3. When the flight does not have the ship in sight at 10 miles
4. When the flight is comprised of more than two aircraft

14-38. Which of the following conditions applies when the air ops officer specifies a Case III approach procedure?
1. CATCC controls both the descent and the approach
2. CATCC controls the descent until VFR conditions are reached
3. No control is exercised by CATCC, and the aircraft is switched to the tower when the pilot sees the ship
4. No control over the descent is exercised by CATCC, but CATCC does control the approach

14-39. Aboard CVs equipped with PAR, a precision final approach is required for which of the following types of recoveries?
1. Case I
2. Case II
3. Case III
4. Case IV

14-40. Instrument approach procedures for jet aircraft operating from CVs stipulate that the transition to approach speed and landing configuration will normally be commenced at what position on the final approach?
1. Platform
2. Marshal fix
3. 6 nm fix
4. 10 nm fix

14-41. What report should the pilot transmit to the ACLS final controller to indicate that the aircraft's autopilot has engaged with the landing system?
1. Meatball
2. Coupled
3. Needles
4. Command control

14-42. When a pilot is flying a manual approach (Mode II), what report will he transmit to the SPN 42 final controller to enable the controller to check for satisfactory aircraft capability?
1. Needles position
2. Meatball
3. Uncoupling now
4. Command control

14-43. What is the tanker aircraft's visual indication of a good store and sufficient fuel to meet receiver requirements?
1. Rocking the wings
2. Trailing the drogue
3. Thumbs up by the pilot
4. Flashing a green light

14-44. The best altitude at which to conduct an emergency tanking operation during IMC is determined by which of the following personnel or positions?
1. Tanker control
2. CATCC
3. Tanker pilot
4. Emergency aircraft plan

14-45. An LPH is primarily concerned with transporting and delivering marines and the helicopter transportable equipment.

14-46. Aircraft that launch from an LPH should NOT be required to change frequencies or beacon codes until what point in the departure procedure?
1. They intercept the departure radial
2. They report departing the LPH control zone
3. They attain both 300 feet in altitude and cruise configuration
4. They attain visual conditions

14-47. What is the radius of the LPH control zone?
1. 5 nm
2. 2 1/2 nm
3. 3 nm
4. 10 nm

14-48. Helicopters that are marshaled on the 180-degree radial relative to the BRC will hold between which of the following fixes?
1. The 5 and 7 mile DME FIX
2. The 5 and 10 mile DME FIX
3. The 7 and 10 mile DME FIX
4. The 10 and 15 mile DME FIX

14-49. On an LPH, which of the following officers determines the type of approach and required control?
1. Commanding officer
2. Air operations officer
3. Operations officer
4. Landing signal officer

14-50. When the ceiling at the LPH is 500 feet and the visibility is 1 mile, what type of descent/approach is used?
1. Controlled descent/IFR approach
2. Visual descent/controlled approach
3. Controlled descent/approach
4. Visual descent/approach

14-51. Depending upon the proficiency of the AOCC/HDC or embarked helicopter units, what are the absolute PAR minimums that an LPH commanding officer can establish?
1. 100:1/4
2. 200:1/2
3. 300:3/4
4. 400:1/2

14-52. The controlled descent and approach type of recovery should be made with single aircraft only.

Learning Objective: Recognize the uses and limitations of CCA equipment.

14-53. Most shipboard radars differ from land-based radars in what way?
1. They are gyroscopically and/or computably stabilized
2. They are orientated with the ship's heading
3. They have coursors
4. They have variable range control

14-54. The technique used by field controllers to conduct a smooth, controlled approach is to assign large heading changes while the aircraft is at least how many miles from the ship?
1. 5
2. 2
3. 3
4. 4

14-55. What system of the SPN-35 radar compensates for the pitching and rolling of a ship?
1. Compensation
2. Indicator
3. Stabilization
4. Azimuth

14-56. All EXCEPT which of the following equipments is a component of the Automatic Carrier Landing System (ACLS)?
1. Computer
2. Surveillance radar
3. Precision tracking radar
4. Independent beam scanning transmitter

14-57. AN/SPN-42 radar can be used to land an aircraft by means of which of the following modes of operation?
1. Manual approach as in a conventional ILS approach
2. Fully automatic approach
3. Conventional CCA approach
4. All of the above

14-58. The AN/SPN-41 system was developed so that a pilot can monitor his progress during a fully automatic (ACLS) approach.

14-59. If any aircraft is equipped to receive signals from either the SPN-41 or SPN-42 systems for an ACLS approach to a carrier, the need for a CCA controller is eliminated.

14-60. The purpose of the Fresnel lens optical landing system is to provide the pilot with an electronic indication of his relative position with respect to the glide slope.

14-61. If a pilot is correctly approaching a carrier for landing, he should see the yellow bar of light (ball) on the Fresnel lens in what position?
1. In line with the green datum lights
2. Slightly above the green datum lights
3. Slightly below the green datum lights
4. Each of the above

14-62. The PLAT system consists of monitors, synchronization control, video tape recorder, and how many centerline cameras?
1. 5
2. 2
3. 3
4. 4

14-63. A PLAT camera used to monitor general flight deck activities is located at which of the following positions?
1. Centerline 1
2. Centerline 2
3. Captain's bridge
4. Ship's island

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